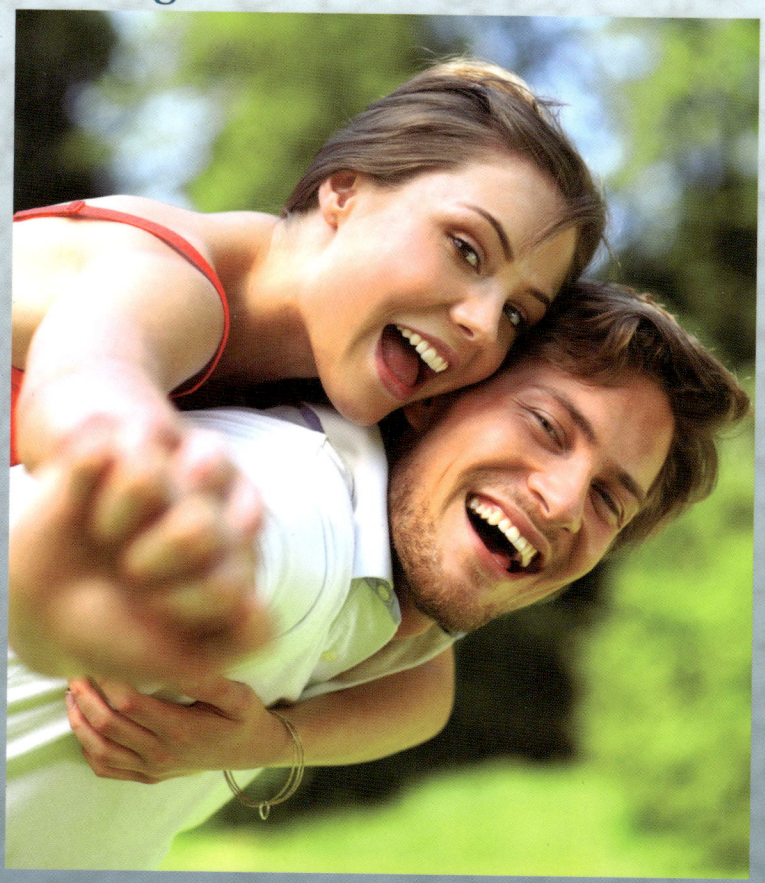
Save Your Breath

Turning Bad Breath into Best Breath



Dr. Mel Rosenberg, Ph.D.

SmellWell

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For further information, please contact: Dr. Mel Rosenberg at melros@post.tau.ac.il

Phone: 972-522-946820

Edited by: Dr. Alon Amit, D.M.D.

Graphics Design and Drawings: Tali Niv-Dolinsky

Photos: Rellu Samuel, Alon Amit, Mel Rosenberg
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Foreword

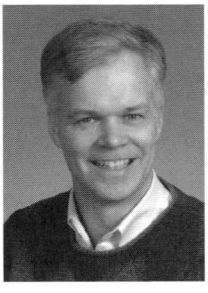
Who hasn't ever thought that their breath smells? This is an embarrassing, maybe even a disturbing thought, but is almost certainly true. We all think we may have had it but bad breath is such a personal problem and one that is not easy to self-diagnose. We tend to overlook bad breath, even when it can negatively affect relationships and provoke considerable and sometimes irrational anxieties.

Mel Rosenberg, the author of this book, is a world-renowned microbiologist and oral diagnostician who has devoted the last 25 years of his scientific career to discovering the causes, prevalence and treatments of bad breath. In this book Mel demonstrates his complete mastery of the subject, demonstrating a remarkable, multi-layered approach to a very complex problem. Readers who think that they alone have bad breath will learn that bad breath is actually universal and has a rich history of scientific and quack approaches to diagnosis and treatment.

I met Mel in the late 1980s during his sabbatical year at the University of Toronto. In a remarkably short period of time his ideas and energetic approach to science transformed much of the research that was ongoing in our department. He wanted to tackle difficult subjects and approach them in ways that nobody had considered before. One of his chief objectives was to study bad breath scientifically. Bad breath, its causes and prevention, were topics that many scientists had avoided but in which the public

showed considerable interest. As a result of his ideas and energy, Mel developed an entire research program on bad breath that flourished in Toronto and that Mel later developed in Israel and at many other institutions around the world where he has taught and consulted.

Mel is a straight-shooter and the material that you discover in this book is astoundingly complete, scientifically accurate and state-of-the-art. If there is something that is known about bad breath, Mel either discovered it or he knows about in depth!!! Readers who think that they are afflicted with this age-old problem will find solace and insight in this one-of-a-kind book written by the master of the subject.



Dr. Christopher A.G. McCulloch
Professor and Canada Research Chair in
Matrix Dynamics
University of Toronto

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This is a book that has taken me almost two decades to write. During this period I have learned a great deal from many colleagues and students. I am indebted to many, but in particular I owe thanks to Dr. Jacob Gabbay (who introduced me to the world of odor-judge testing and Interscan Corporation's technologies), Dr. Chris McCulloch, who taught me many things, including how to organize a clinical study, Dr. Ilana Eli and Dr. Carolyn Tal, who have helped me try to understand the psychological issues, my friend and periodontist Dr. Avital Kozlovsky, who ran critical clinical studies, to the students and technicians from my laboratory, in particular Dr. Ronit Bar-Ness Greenstein (one of the only people to believe in the two-phase mouthwash project during the 'dark days'), Dr. Sarit Goldberg (who has been helping me with my inventions for the past twenty years), Dr. Nir Sterer (who has carefully gone over the manuscript and suggested some key improvements), Dr. Amir Shuster, my former technician Yardena Mazor, and my current technician, Yael Gov, my breath odor colleagues Dr. John Greenman, Dr. Israel Kleinberg, Dr. Walter Loesche, Dr. Daniel van Steenberghe, Dr. Hideo Miyazaki, Dr. Ken Yaegaki, Sushma Nachanani, Pat Lenton, and Georgia Majerus, who are key figures in the establishment of the International Society for Breath Odor Research. I thank Dr. Anton Amann, co-editor in chief of the Journal of Breath Research. I acknowledge the help and advice of friends from the flavor industry, in particular Mike Munroe and Arnold Machinek. I am also grateful to Chaim Regev and Dr. Shimon Goldstein, who launched the first two-phase mouthwash and Dr. Philip Stemmer, who launched the second, to my co-worker during the early years, Dr. Ervin Weiss, to Dr. Herbert Judes who was instrumental in bringing me to the Dental School, the late Sy Weinstein of Warner-Lambert, who believed in me, Dr. Yoel Konis, who prompted me to launch the first CPC experiment, and my late dear friend Dr. Ron Doyle, who helped me interpret the results. I received helpful advice on diabetes and breath odor from the late Dr. Charles Hollenberg and on xerostomia and dry tongue

from Dr. Leo Sreebny and Dr. Dov Abrams. I was very fortunate, early on in my career, to meet the late Dr. Joe Tonzetich, the scientist who turned breath research into a modern discipline. I am also particularly grateful to Dr. Eugene Rosenberg, who practically single-handedly made a scientist out of me, to my wife Shulamit, who has had to put up with decades of smelly experiments in and around the house, and to my children, Assif and Adar, who make it all worthwhile. Finally, to my former student and current colleague, Dr. Alon Amit, who has done a fine job editing this manuscript, Roniet Berci, my administrative assistant and Tali Niv-Dolinsky for her artwork and production skills.

Founding members of the International Society for Breath Odor Research, 1995, Belgium

About the Author

Dr. Mel Rosenberg is Professor of Microbiology at the Sackler Faculty of Medicine and the Maurice and Gabriela Goldschleger School of Dental Medicine, Tel Aviv University. He has also held honorary appointments at the University of Toronto University of Pennsylvania, University of Rochester and the University of London Eastman Dental Institute.

Dr. Rosenberg is a leading international authority on the causes, diagnosis and treatment of bad breath (halitosis). He has edited two books for clinicians and academics, and published dozens of scientific papers in prestigious peer-reviewed journals, including "Scientific American," and the "Journal of Dental Research" on the diagnosis and treatment of bad breath.

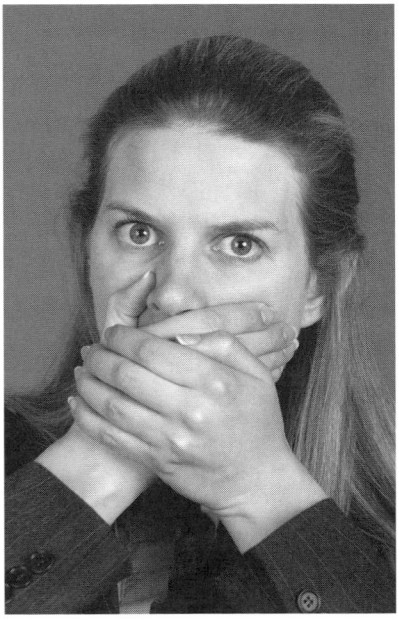
Dr. Rosenberg has lectured to dentists, physicians and researchers on five continents. He has developed methods for measuring bad breath that are used around the world, and is inventor of Dentyl pH, a leading international mouthrinse. He co-founded the International Society for Breath Odor Research (ISBOR) and serves as co-editor-in-chief of the "Journal of Breath Research."

Dr. Rosenberg is also a writer of children's books (www.meltells.com) and a jazz musician (www.melrosenberg.com).

Part One: Getting Reliable Information

Introduction – The Bad Breath Paradox

Worried About your Breath?



Since this is a book about bad breath, I am going to assume for a moment that you are worried about your own. Well, join the club, I mean, who isn't?

I've just returned from an international conference on bad breath. There were many other international experts there, and *some of them* have bad breath. Maybe I do too. Are you surprised? My colleague, Dr. Ervin Weiss, once suggested that whenever I give a lecture on the subject, I ask whether anyone in the audience thinks their breath is absolutely fine. If anybody raises their hand (a rare occasion) I bring that brave person up to the podium and smell him or her, right then and there. Sometimes they don't have bad breath, and sometimes they do. But most of us will never raise our hands because we are worried that we might have bad breath. We know how embarrassing it is.

Most of us do have bad breath once in a while, for example when we get up in the morning, or when our mouths are very dry. But some people seem to have bad breath most or all of the time. Perhaps twenty percent of the adult population has chronic bad breath. We all know someone like that. Our third grade teacher. The guy next door. The dentist. A parent. And this makes us nervous. "*What if I have it and other people can smell it*?"

How NOT to diagnose bad breath by yourself

- Cup your hands over your nose and mouth, breathe out from the mouth and try to smell your own breath.
- Lick your wrist, let the saliva dry and then smell the residue.
- Smell the telephone receiver after you talked.
- Smell the floss, toothbrush or toothpick you just used.
- Smell the food you just took a bite of.
- Hide under your blanket and smell your own breath.

Even when we do detect a smell, we can't tell how bad our breath actually is. For example, everyone's tongue smells to some extent, whether or not they have bad breath.

The problem is that although we have little trouble smelling other people's bad breath, it's exceedingly difficult to figure out whether we have it or not. People who are worried about bad breath develop all kinds of ways to try to smell themselves. They cup their hands over mouth and nose, smell themselves under the blankets, lick their wrists, and so on. Indeed, an odor is sometimes present, but figuring out how bad it smells to others is difficult. Although I have smelled the mouths of thousands of people, I can't determine how bad *my own* breath actually is.

In other words, our sense of smell can *detect* our own breath odor, but our brain interprets the data in terms of our subjective preconception. The result is that we are highly objective when it comes to smelling other people's breath, but subjective when it comes to assessing our own. This is described in greater detail on page 26.

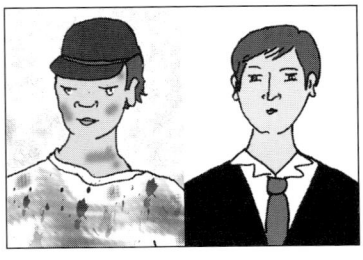
For example, in an experiment we conducted at Tel Aviv University in the 1990s, when 52 subjects licked their wrist and were then asked to gauge the odor, they gave themselves scores more than twice as bad as the

objective judge, and with no correlation with the actual level of odor (but with a high correlation with their preconceived notion of how bad the smell should be).

To sum up, we are much better assessing other people's odors than our own. We smell other people's bad breath and then worry about our own. About twenty percent of the population worry a lot about bad breath (not necessarily the same twenty percent that actually suffer from bad breath!). About 0.5% (one in two hundred) worry incessantly, to the effect that it interferes with their entire lives. Ironically, many worriers probably take better care of their oral hygiene, and are likely to have much better breath, than a lot of non-worriers.

Many people don't care whether they have bad breath or not. They may not take good care of their mouths. They don't come to my lectures, they don't surf the net looking for cures, and they are not likely to buy this book. They don't care. They don't wonder. It's not surprising that some of *them* have bad breath. But when we smell how bad *their breath* is, we become even more worried about our own.

This is what is called the *'bad breath paradox'* - many people have chronic bad breath but don't know it; the rest of us end up wondering whether our breath is as bad as theirs is.



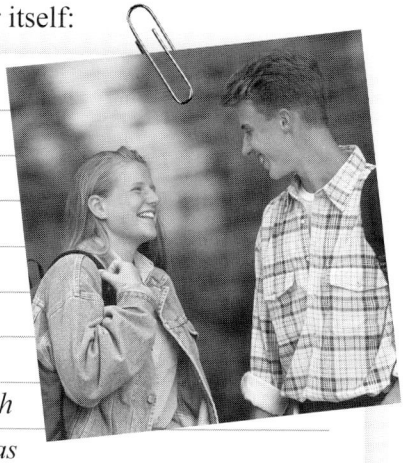
There is a famous old Jewish story that illustrates this point. Two fellows go down a chimney. One comes out dirty, the other clean. Which one runs to wash himself? If you think it's the dirty guy, you're wrong of course! He sees how clean his partner is, and assumes he is just as immaculate. But the clean guy sees how dirty his companion is and assumes that he is dirty too. He runs to take a shower.

If you've gone to the trouble of obtaining this book, chances are that you do practice good oral hygiene and visit your dentist and hygienist regularly.

I'll try to keep that in mind as we progress. If not, I'll try and persuade you how important it is, and give you some useful tips. Cleanliness, as the saying goes, is next to Godliness. It also helps you smell better!

The Problem of Letting Someone Know

Perhaps, you have bought this book for someone you know who has bad breath. If you can tell them, terrific! It's not easy to tell anyone that they have bad breath. You probably won't want to tell strangers at the bus stop or at the local restaurant. If you tell someone at work or a friend about the problem, you are a real hero/heroine and I salute you. But be forewarned: they may not initially be appreciative. However, they may acknowledge your altruism, courage and kindness over time. See the e-mail I once received on this subject below, it speaks for itself:



"When I was at university, I met an acquaintance on the street once and we got talking about what we were planning to do later that day. I said that I was going back to my apartment before going out again later that day.

He said 'Perhaps you should brush your teeth while you're at home.' I was shocked for a moment, and considered feeling offended, but a moment's thought made me realize that he had in fact done me a favor."

There is no way that I know of to tell someone that they have bad breath without possibly hurting their feelings. After all, it's an intimate problem. But there are ways to tell someone kindly. I am in favor of the direct, but kind, approach.

You: "Betty, please don't be upset with me, but as your close friend, there is something that I feel I have to share with you. Lately, I've noticed that now and then, you have some odor on your breath. Perhaps it is something you've eaten. I worry about bad breath myself, so we should look into what the cause might be, and deal with it."

If such a direct approach is a problem, you can try an indirect approach, such as leaving this book hanging around. If they ask, you can always tell them that you bought it for yourself, but they're welcome to have a look at it as well. If they ask you, "Do I have a problem with my breath?" you can answer "Sometimes. Doesn't everyone?" I don't expect you to tell casual acquaintances at work that they have bad breath. Indeed, in a study completed in South Africa just a few months ago, 83% of the people asked said they would not tell a colleague they have bad breath, and two thirds would not tell a friend. I have worked at several dental schools for over two decades, and some of the professors I encountered had chronic bad breath. Their patients, students and peers all knew. But I never told any of them (except the very few who asked). Bad breath is embarrassing for all of us, but for dentists, it is even more problematic. Have a look at this quotation from D.C. Hawxhurst, written over 130 years ago (1873):

> *"It is folly for the practitioner to underrate the influence which a bad breath may exert in driving his patients from him. Under my own observation several operators have suffered seriously from this cause."*

I don't expect people to tell their dentist if he (or she) has bad breath. But I do expect you to 'come clean' with family members and good friends that you *really* love and care for. In this case, you have a moral obligation. This is because:

- Bad breath can severely affect someone's life, without him or her ever knowing.
- It's usually treatable, often within hours.

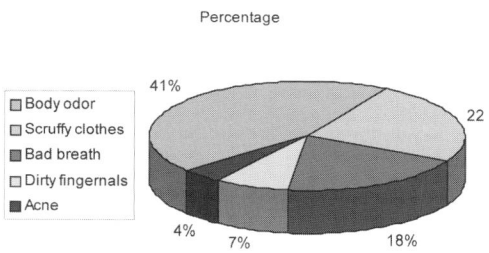
According to two surveys carried out for the British Dental Association in 1999 and 2000, people with bad breath are less likely to be promoted at work. Among 1,021 persons surveyed, 59% of the males and 72% of the females would not date someone who had bad breath.

In addition, the survey asked respondents:

What is the most unattractive feature that a person can have?

The answers were:

Body odor	41%
Scruffy clothes	22%
Bad breath	18%
Dirty fingernails	7%
Acne	4%



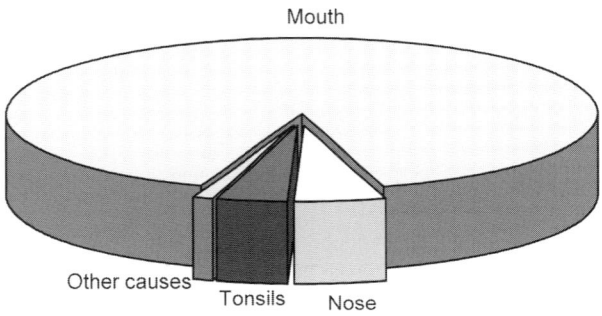
We see that body and breath odors are among the most potent ways to turn off a date. By the way, in case you are also interested in coping with body odor, you are welcome to find out more at www.smellwell.com.

Certainly, not everyone has the guts to tell a friend that he or she has bad breath. However, at the very least, we should be prepared to level with the ones that we love and hope that should the need arise, they will reciprocate in kind.

Do you have any additional suggestions on how to tell a friend that he has bad breath? Do you want to share your experience? Would you like to hear how other people dealt with their bad breath problems or confronted their friends and family? Go to http://www.smellwell.com/forum and share your experience with others!

Bad Breath in a Nutshell

1. Most of us have bad breath once in a while.
2. For about twenty percent of the general adult population, it is a common occurrence.
3. Bad breath originates in the mouth itself in 85-90% of cases. Bad breath from the nose occurs in about 5% of cases, and from the tonsils in about 4%. Bad breath from other sources is, therefore, relatively rare.
4. The back of the tongue accounts for most of the odor.
5. Bad breath usually gets worse when our mouth dries out.
6. Most cases of bad breath are caused by bacteria breaking down proteins.
7. Bad breath almost never comes from the stomach.
8. Most cases of bad breath can be treated by professional dental treatment, oral hygiene and other simple home methods. However, daily maintenance is required (that is, no 'quick fixes').



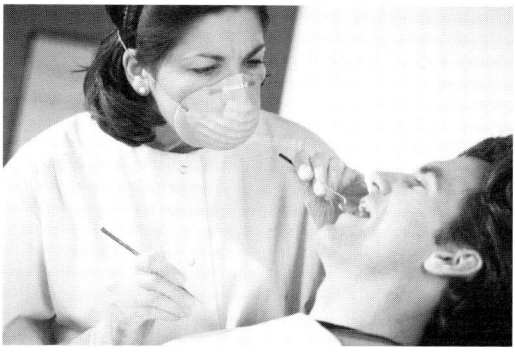
Distribution of the Origins for Bad Breath

Involving the Health Professionals

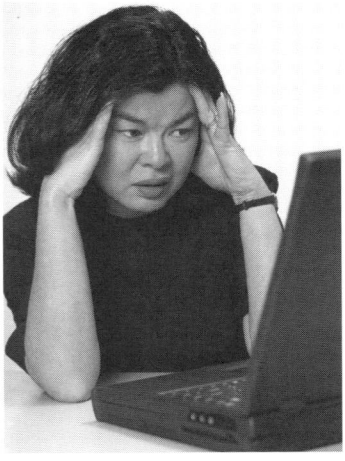
I wish most physicians and dentists knew more about bad breath. In an ideal world, any physician or dentist should have been taught to competently diagnose and treat this problem. Unfortunately, this important condition is ignored in most dental and medical school curricula.

Part of the reason for this is that bad breath doesn't fit under any of the individual subjects and disciplines that we teach our students. It crosses over many fields and is multifaceted. It involves, in addition to general medicine and dentistry, microbiology, biochemistry, physical and analytical chemistry, and psychophysics. I hope that someday it will be an important part of what our students must learn to become competent healers. Any physician or dentist reading this book is welcome to skip to the 'fact file' at the end of this book. Medical health professionals (and the public) can also watch an interview with Dr. C.A.G. McCulloch, recorded at the television studio of the University of Toronto. The video can be viewed at this website: http://tinyurl.com/bbinterview

Please keep in mind that I am a microbiologist by training, not a physician or dentist. I have made every effort to base my writings and lectures on research and extensive clinical experience. Do make sure that any dental or medical procedures you undertake are carried out under professional supervision. Your own doctor, dentist and hygienist are more than welcome to e-mail me directly at *melros@post.tau.ac.il*.



The Issue with Websites



Websites may provide poor and even misleading information on bad breath, even though they sometimes represent reputable medical establishments. The information on bad breath on such websites is usually written by a dentist or physician who has not done research on the subject, and who is sometimes misled by uninformed sources.

So be cautious: not everything you read on the internet about bad breath is accurate or helpful.

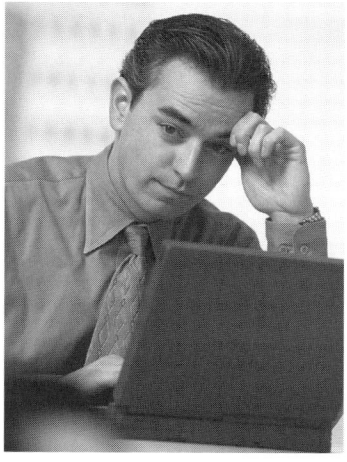
I'll quote some of the mistakes and otherwise misleading comments I found on some of the most popular websites on bad breath:

"What you eat affects the air you exhale. *Certain foods, such as garlic and onions, contribute to objectionable breath odor. Once the food is absorbed into the bloodstream, it is transferred to the lungs, where it is expelled. Brushing, flossing and mouthwash will only mask the odor temporarily."*

Actually, most of the odor of garlic and onions remains in the mouth and can be removed by oral hygiene procedures. The lung component is the minor one.

"Bad breath can also be caused by dry mouth (xerostomia)..."

Actually, people with xerostomia (chronic dry mouth, a medical disorder) do not seem to have more bad breath than others, perhaps because of the increased acidity in their mouths. Bad breath does tend to increase at times during the day when our mouths dry out, but this is a normal occurrence and not a chronic medical condition. See also page 44.



*"**Bad breath may be the sign of a medical disorder**, such as a local infection in the respiratory tract, chronic sinusitis, postnasal drip, chronic bronchitis, diabetes, gastrointestinal disturbance, liver or kidney ailment. If your dentist determines that your mouth is healthy, you may be referred to your family doctor or a specialist to determine the cause of bad breath."*

This is misleading. The major cause of bad breath is probably postnasal drip which putrefies on the very back of the tongue. This is an oral problem, so dentists should be your first point of call, even though but some will only look for problems with dentition, and may miss the tongue as the focus of the problem.

"You may not always know that you have bad breath. That's because odor-detecting cells in the nose eventually get used to the smell. Other people may notice and react by recoiling as you speak."

This is probably not the case. Otherwise people with bad breath couldn't smell other people with bad breath. More likely we have a psychological difficulty in assessing the level of our own odor. Also, since we breathe out while speaking in a horizontal direction through our mouth, and breathe in vertically, the two air streams are pretty distinct (otherwise, we would be breathing in the carbon dioxide we exhale).

When people 'react by recoiling' when you speak to them, it may be because they don't want you to smell them. In any case, it is a mistake to try to infer whether or not you have bad breath from the behavior of others.

"Mouthwashes are generally cosmetic ***and do not have a long-lasting effect on bad breath****."*

This is of course wrong. Most mouthwashes do have antibacterial agents and some are effective for many hours if gargled before bedtime, and not used at the same time as using toothpaste (read further on page 117).

"Most bad breath originates in your mouth. The causes of bad breath are numerous. They include: food, dental problems, dry mouth, diseases, mouth, nose and throat conditions, tobacco products and severe dieting. "

Oops - They describe many rare causes for bad breath, but forget to mention that bacterial activity on the tongue is actually the major cause.

"Basically, all the food you eat begins to be broken down in your mouth. As foods are digested and absorbed into your bloodstream, they are eventually carried to your lungs and given off in your breath. If you eat foods with strong odors (such as, garlic or onions), brushing and flossing - even mouthwash - merely covers up the odor temporarily. The odor will not go away completely until the foods have passed through your body."

Actually, the odor after eating pungent foods comes mostly from remnants remaining in your oral cavity, unless you burp, that is. Most of the odor after eating garlic and onions comes from remnants in your mouth, rather than your lungs.

"The medical condition dry mouth (also called xerostomia) can also cause bad breath."

Probably not – people with xerostomia are considered to have little bad breath (see above).

"There are ways to accurately smell your own breath. However you have to take a slightly indirect route.

Try this technique. Lick your wrist, wait about five seconds while the saliva dries somewhat, and then smell it. What do you think? That's the way you smell. Or, more precisely, that's the way the end of your tongue smells (your tongue's 'anterior' portion). How was it? Did you pass this first check?

Now try this experiment. It will check the odor associated with the back of your tongue (your tongue's 'posterior' aspect). Take a spoon, turn it upside down, and use it to scrape the very back portion of your tongue. (Don't be surprised if you find you have an active gag reflex.) Take a look at the material that has been scrapped off, usually it's a thick whitish material. Now, take a whiff of it. Not so bad? Pretty nasty? This smell, as opposed to the sampling from the anterior portion of your tongue, is probably the way your breath smells to others."

Both these tests were developed and tested in my laboratory and clinic. Both are helpful if the person doing the testing is an objective odor judge. However, as we were somewhat surprised to find, neither test is useful if someone worried about bad breath is doing his/her own testing. People are quite incapable of giving themselves an objective score concerning something they are concerned about.

"Bad breath can be reduced or prevented if you practice good oral hygiene. Brush twice a day with fluoride toothpaste to remove food debris and plaque. Brush your teeth after you eat (keep a toothbrush at work or school to brush after lunch)."

Brushing teeth, although important in itself, is relatively ineffective in reducing malodor in the short term. Since the main cause for oral malodor is the tongue, gentle cleaning of the tongue dorsum is advisable, in addition to the 'brush and floss' routine, to reduce bad breath.

The Issue with Companies and Products

There are a lot of companies out there selling products that they claim will solve your breath problems. Some are helpful, others less so. Companies want to make money, to provide value and profit for their shareholders. They are interested in coming up with products that consumers will buy.

Here's the rub. If you are interested in buying a hair color product that will tint your hair blonde, you can see whether it's working or not. But if you buy a product for breath, you probably won't know whether it's working or not, because research has shown that people aren't good at assessing their own breath. So people tend to rely instead on what the companies call 'cues', which are indications to the consumer that the product *appears* to be working. According to a recent poll, one important cue that a mouthwash is working is the clean and fresh feeling in the mouth. That, however, may or may not reflect the actual efficacy of the product.

A strong, burning sensation is another cue. So is a minty taste. Many people assume that these are indications that a particular product is working. However, this may or may not be the case.

Most of the mouth-burning mints and candies "suck", as far as fixing bad breath is concerned.

Another 'burning' issue with products is the use of mouthwash. Many mouthrinses contain alcohol. Alcohol is a good preservative and is considered a strong disinfectant. The burning and cooling sensations may be misleading. There are several problems with alcohol:

1. Some bacteria and fungi in the mouth can convert the alcohol, yielding chemicals such as acetaldehyde, which is both toxic and smelly.
2. Alcohol may dry out the mouth, creating an environment that might promote, rather than inhibit, bad breath.
3. Alcohol is not advised for use by children and by rehabilitating alcoholics.
4. Some very recent studies have suggested that alcohol-containing mouthwashes may increase the risk of mouth and throat cancer.
5. Certain religions, such as Islam, prohibit alcohol intake.
6. Alcohol can interfere with the local immune response, which otherwise combats oral microorganisms.
7. Alcohol may render the oral linings more permeable to various toxic compounds.

Finally, some companies have, for many decades, promoted breath products by using the 'fear factor'. In such advertisements, they might, for example, show a single lady, stating "she might have gotten married had her breath been fine," as a cunning method of improving sales to those who might or might not have an actual breath problem.

The First Step on the Way to Better Breath

If you have bad breath, you probably want to find out as quickly as possible. You don't want to wait around for years for someone to tell you. *That is why you have to ask.* This is the first and most crucial step in taking care of your breath. It's the most important way to find out if you're okay. I didn't say that it is easy. I realize that asking *anyone* about something this intimate is a difficult thing to do. But consider this - you can pay an expert hundreds of dollars to smell you, but asking a family member or close friend is cheaper and more productive. This person whom you trust, your **'confidant'**, should be someone close to you, both physically and emotionally. If you do have a breath problem, your confidant is probably already aware of it, so you have little to risk. You should avoid asking young kids (although it may be easier and not as embarrassing as asking an adult in your family), because children often exaggerate minor odors, turning them into gargantuan ones.

When I examine people in my clinic, I insist they bring along a confidant, to make sure that I receive the input of a person close to the patient. Having such a confidant is a first and critical step in treating bad breath.

The confidant has seven critical functions:

1. The confidant can save you years of endless self-torture and waste. After all, if you do have bad breath, you want to know. It's almost impossible to find out by yourself. So, embarrassing though it may be, you have to ask.

2. If you do have bad breath, you can almost always fix it. The large majority of cases are amenable to treatment, and your confidant can help you throughout the process.

3. Perhaps your breath is not as bad as you think. Maybe it occurs only occasionally. Your confidant can examine your breath once in a while and give you objective feedback on how bad it actually smells.

4. If your confidant tells you that you do have bad breath on a regular basis, the problem can often be treated and monitored in the privacy of your own home, without the need for frequenting special breath clinics, and, of course, without the associated financial costs and embarrassment.

5. A confidant is someone with whom you can share your worries. Talking with someone you trust about such an intimate concern can be almost like draining pus from a wound. The social anxiety implicit in worrying about this problem can cause a great deal of misery, and having someone who can help you cope is of great importance.

6. If there *is* a breath problem, your confidant can help you and your health professional figure out where it's coming from.

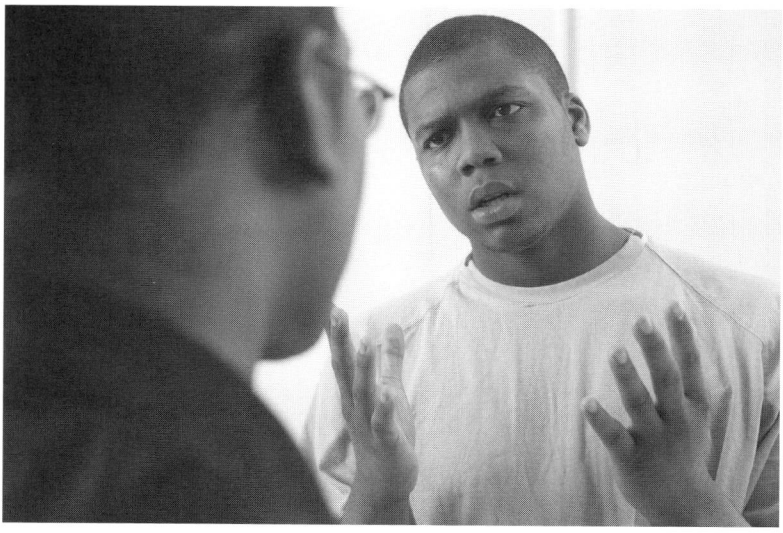
7. Your confidant can help you determine whether a particular treatment is working or not, and make sure that your breath continues to be clean and fresh.

As I explained earlier, I worry about having bad breath too. After all, I make a living telling others how to avoid it. So I do the simple thing too. I ask someone in my family to tell me whenever my breath is even slightly bad. Usually that someone is my father-in-law or grown up son. And on occasion, whenever necessary, they do let me know when the situation arises.

You might be interested to learn that the idea of enlisting friendly help is not new. In 1873, D.C. Hawxhurst cautioned his dentist colleagues to avail themselves of the kindly offices of *"some trustworthy friend"*, to let them know if they suffered from bad breath (Dental Register, 1873 27:105-110).

So, to summarize, anyone who is worried about bad breath should take the plunge and ask someone (spouse, brother, parent, close friend). Ideally the confidant is someone you meet on a regular basis. The closer you feel to this person and the more you trust him or her, the better. If your confidant tells you that you do indeed have a breath problem, then please go ahead and continue reading below. If your confidant does not think that you have a chronic breath problem, you might want to jump directly from here to page 130 and only after reading Part 3, continue below.

If Your Confidant Confirms You Do Have Bad Breath



Initial testing

Your confidant, someone close to you whose opinion you trust, has told you, hopefully in a kind but direct manner, that you do have a breath problem. First, please thank this person for this uncommon act of kindness. After all, it's not easy to tell anybody (even somebody in your family) about such an intimate matter.

Please ask your confidant to spend another moment to help you determine where the odor is coming from. This will help greatly with diagnosis and treatment. Ask your confidant to smell the breath coming out of your mouth when you talk (for example, count out loud to twenty – this is what we do in the clinic). Then ask your confidant to smell the breath when you breathe out through the nostrils (if your nose is often stuffed and you have trouble exhaling through your nostrils, you may be a mouth breather, which can cause your mouth to dry out, itself a risk factor for oral breath – see page 46).

Steps towards a more objective diagnosis

- Get a 'Confidant' – An adult you trust who is close to you (a parent, a good friend, a sibling). Trusting your own judgment just isn't good enough, and inferring from other people's actions can be misleading.
- Ask your confidant to confirm whether or not you do have a breath problem. If you do have such a problem, he or she may have already been aware of it, and if you do not, your confidant will tell you so. You might be pleasantly surprised and relieved!
- If you do have an odor, ask your confidant to check whether the odor is coming from your mouth or nose.
- Ask your confidant to assess whether the odor is persistent, or is reduced after practicing oral hygiene or eating a healthy meal.
- Try the different treatment strategies suggested throughout this book, and have your confidant tell you which are best at controlling the odor.

At this stage, you are halfway towards solving the problem! Your confidant has helped provide you with an initial 'differential diagnosis'.

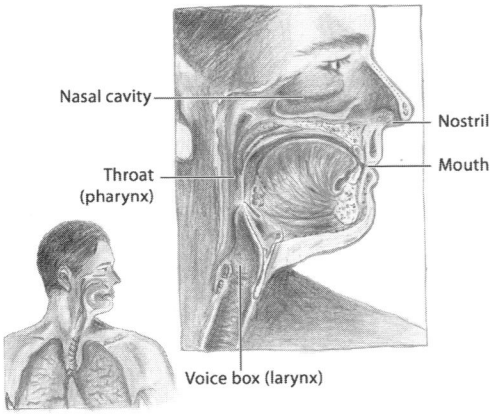
It your confidant's answer is 'yes,' it is highly likely that your concern is founded. In most instances, the confidant will notice that the odor comes mainly from the mouth. This is because bad breath comes from the mouth itself in some 85-90% of cases (we are talking here about people who are not bedridden or otherwise suffering from a serious disease). In about one out of twenty cases, the odor will be felt strongly from the nose, rather than the mouth. In this instance, it may originate in the upper nasal passages. Nasal odors usually smell quite distinct from oral odors. Tonsils may also be responsible for some 3-5% of cases, although there is controversy among specialists as to the overall contribution of tonsils in bad breath.

In the rare scenario that your confidant smells the same odor coming from both mouth and nose, this may be related to an extrinsic source (tobacco smoke, onions, garlic, alcohol), or, very rarely, a medical problem which is causing odor to escape from the lungs. As we'll discuss soon, bad breath almost never originates in the stomach.

If the odor is coming primarily from your mouth, then I suggest that you contact a caring dentist. If the odor is coming mainly from your nose, start out with your family physician who may recommend an ENT specialist who can carry out an endoscopy of the nasal passages. If the odor appears to be coming from both your nose and mouth, then your physician is the person to talk to. In all these instances, I am glad to be of assistance at melros@post.tau.ac.il.

Part Two: The Origins of Bad Breath

Why Things Smell



The air that we inhale does not usually smell (unless we are sitting next to a smoker). How does it become contaminated with odors? If we breathe in through our noses, the air races through the upper nasal passages, where it is warmed, through the bronchi to the lungs, where some of the oxygen is taken up and carbon dioxide released. Neither of these gases has an odor, however. When we breathe out through our noses, the air makes the same return trip. If there is an odor, then it is due to the presence of molecules picked up along the way.

Let's look at my friend Jane, for example. When Jane breathes out through her mouth, the air encounters her trachea, and then passes over her tonsils, tongue, hard and soft palate, inner cheeks, teeth and gums. Only then does the air come out. The air wafting over these surfaces can collect a whole bouquet of redolent molecules from billions of Jane's bacterial residents.

What determines which molecules enter the air Jane breathes? First of all, there is the issue of volatility. Some molecules prefer being dissolved in water, and even when the water on a surface dries out they stay stuck to the surface. Others (many thousands of different kinds) prefer to pass into the air. As the air travels over Jane's tissues, it collects the volatile molecules as they are released. When the water film over the mucous membranes in her mouth dries out (as is the case when the mouth dries out) greater numbers of volatile molecules join the flow.

If the tissues are moving (as is the case when Jane speaks) the 'mass transfer' of volatile organic molecules into the air is even greater.

Some of these molecules can be detected by the nose at very low concentrations. Different molecules tend to have distinct smells, and trained sniffers (such as the 'noses' in the perfume industry – the professional perfumers who concoct our perfumes) can readily identify thousands of different odor molecules and combinations.

The molecules in the air

Some of the molecules that enter the air we breathe are 'invisible' to our nose, so that our receptors do not react to them. This includes the molecules making up the air itself. Some organic molecules that have relatively little smell (such as certain alkanes) are candidates for helping scientists and physicians diagnose various types of cancer and other major diseases.

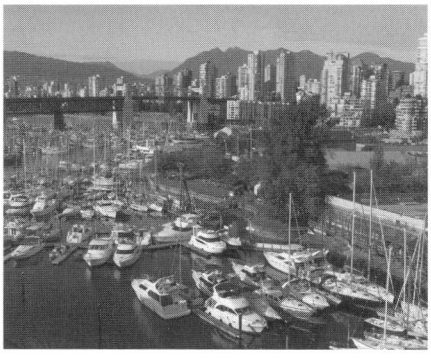
Volatile molecules

There may also be volatile molecules that we release from our bodies (primarily the underarm and groin, but possibly also the breath) that affect the brain and are able to elicit changes in our behavior. Such molecules are called 'pheromones'. Animals have them, and we appear to as well. They are often connected with sexual signals, but may convey fear and other messages. In females, molecules from the armpit of one female can synchronize the menstrual cycle of other females in her vicinity. Interestingly, we may not even be aware of their presence.

Let's say that Jane suffers from bad breath, and that her friend Peter is in her vicinity. Jane's exhaled breath swirls up through Peter's nostrils, over a bony area, to a 'sheet' about the size of a small coin containing millions of olfactory receptor neurons. This is the olfactory epithelium. Special receptors there are sensitive to the individual molecules that they encounter, and create electrical signals as a result. These signals travel to Peter's brain and are interpreted in terms of the kind of smell, how strong it is, and how appealing it is.

To an extent, the brain's reaction to a given smell is subjective and based on experience. Some of us like the smell of pine, whereas others do not. A certain perfume may be appalling to some yet appealing to others. But when it comes to the gases that make up bad breath, there seems to be a general consensus: bad breath is *bad.*

Where do the Smelly Molecules of Bad Breath Come From?



Bad breath begins in an overcrowded microscopic harbor. There, countless individuals eke out a meager living, under unbelievably cramped conditions. As you might expect, one of the main problems is pollution – the toxic wastes build up relentlessly, and the stench is perceived from afar.

There are many such microscopic harbors in everyone's mouth – mainly in tiny crevices in the tongue, and between the teeth and gums. The individuals in this context are billions of bacteria, and they are chiefly responsible for what we know as *bad breath*. If you consider that such microbial deposits may only be a few millimeters in size, and that the odors they produce emanate an arm's length or more, it's like being able to smell the pollution of Los Angeles all the way to Portland, Oregon.

What odors do the bacterial masses in the mouth produce? These include sulfur-containing molecules, such as hydrogen sulfide (the smell of rotting eggs) and methyl mercaptan (another sulfur-containing molecule). These molecules are signs of bacterial activity. Non-sulfur gases produced by bacteria include butyric acid (smell of puke), and nitrogen-containing gases, such as putrescine (smell of putrid decay), cadaverine (its name speaks for itself), indole and skatole (fecal smelling molecules). These molecules are signs of decay and sometimes disease. So it's not surprising that, by and large, we are put off by these odors. Maybe it's a kind of primitive warning system – don't drink this water, don't eat this meat, stay away from this infected person or animal. Thus, you should not be surprised if I tell you that many of the foul odors we encounter on a daily basis come from microorganisms. The smell of feces, flatulence, sewage,

manure, wet sponges, spoiled food, underarms, and sneakers all come from microorganisms busy doing their thing.

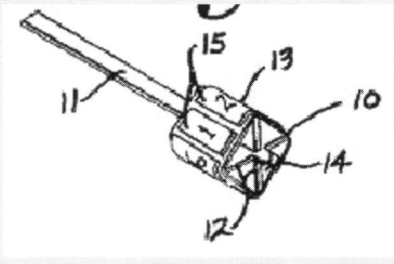
These gases produced by bacteria are picked up by our noses at excruciatingly low levels. We can smell some of these molecules at a dilution of over 100 million to one. Perhaps that is why there is no device invented yet that can match the sensitivity of the nose when it comes to these putrid molecules.

Hand Held Gadgets

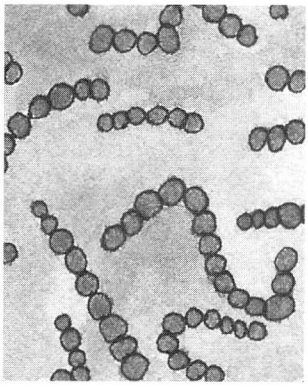
Other inventions

Inventors have been trying to develop home breath tests for decades (see, for example, US patent 3,507,269 invented by Homer H. Berry, of Kansas City, Mo., in 1970 for a handheld gizmo that would tell you whether you had bad breath, using chemical tests on absorbent materials). The patent, by the way, is long expired, in case anyone is interested in further pursuing this direction.

Once in a while, a company comes out with a handheld gadget purported to measure bad breath. Ironically, one was called the 'iki iki' sensor. Similar gizmos are offered over the internet. We have not yet found one that works. When someone comes out with a reasonably-priced, reliable fist-size breath tester, it will be quite a hit.



The Mouth as a Bacterial Jungle



The mouth is one of the most bacteria-infested parts of our bodies. In a spoonful of saliva, we may easily find over a billion bacteria (only our large intestines contain more bacteria). Saliva, when it is originally produced in the various salivary glands, has no bacteria at all. Thus, the billions of bacteria in the saliva in our mouths are all new arrivals, many having been sloughed off the tongue and teeth just seconds previously.

How did all those bacteria get into our mouths? A moment before we are born, we are sterile, free of bacteria. But as soon as we enter the world, we begin a lifelong relationship with resident microbes on our skin, in our intestines and in our mouths. Many of them are helpful, others have evolved to live with us 'side by side' (or perhaps, 'side by inside'), neither harming nor helping us (commensal). Many of the species that colonize us were passed on (e.g., by kissing) to us from our parents. This, of course, gives a new meaning to the expression 'spitting image'.

The types of bacteria that colonize our mouths as youngsters often continue to live with us for life and we pass them on to our children, when they are young. Of course, that doesn't mean that we can't 'catch' the occasional species from a friend or spouse. Perhaps by now you are thinking, "If only the bacteria in the mouth could be completely eradicated, bad breath would be licked." Indeed, people who take antibiotics for some ailment often experience a big improvement in their breath odor. For example, you may be taking an antibiotic to fight off a bladder infection or a gastrointestinal ailment. Once you swallow the antibiotic, it gets into your bloodstream and spreads throughout your body. When it reaches your mouth it inhibits or kills many of the smelly oral bacteria. Breath odor often goes down for a couple of weeks following antibiotic therapy, and

then tends to climb back up to previous levels as the bacteria repopulate the mouth. For better or for worse, we cannot and should not eradicate all the bacteria in our mouths, whether or not they smell. To an extent, we need them. When the level of bacteria in our mouths becomes too low, we risk infection from oral fungi (Candida). Such infections are harder to eradicate than bacterial ones. Candida cells are commonly found in people's mouths, but the bacterial population prevents them from proliferating and causing damage.

But just because we need oral bacteria does not mean we should let them go wild. In addition to bad breath, oral bacteria cause dental caries and gum disease. So the idea is to carry out good oral hygiene on a regular daily basis. We won't get rid of the bacteria, but we'll keep them at a level where they won't cause odors and other damage and will prevent the Candida from populating the oral surfaces.

Odor Production

Bad breath generally arises from the breakdown of proteins by bacteria in the mouth. In general, when bacteria have access to proteins, they produce foul odors. They produce much more odor if the oxygen concentration is low. Such is the situation in many parts of the mouth. This is because the bacteria on oral surfaces tend to grow in layers that can be hundreds of bacteria deep. The bacteria at the external edge of these layers (called biofilms) are aerobic and can respire, similar to our ability to utilize oxygen. They quickly scavenge the oxygen diffusing into the biofilm. That means that deep within the film the conditions are anaerobic (very little oxygen). Under these conditions, the types of bacteria present readily break proteins down into amino acids, the individual building blocks that make them up. Some of these amino acids can be further broken down by the bacteria to yield odorous gases. In summary, most cases of bad breath are due to the anaerobic breakdown of proteins in the mouth by bacteria. That's bad breath in an eggshell.

> The proteins that feed bacteria in the mouth may come from the food that we eat. If you didn't clean your teeth properly, you might find a piece of meat from dinner last night still stuck between your teeth. *Give it a whiff – see what I mean?*
>
> That is why it's so important to clean your mouth after you've eaten anything rich in protein, especially milk, fish, and dairy products.

Bacteria in the mouth don't only digest the proteins present in food remnants we leave behind in our mouths. They also break down *our own* proteins. We are constantly shedding ('sloughing') the surface of the soft mucosal inner "skin" in our mouths, from our cheeks but particularly from our tongues. This shedding is part of our defense system, and allows rejuvenation of the inner skin of our mouths (oral mucosa). These shed cells are chock full of proteins and can be degraded by the bacteria sticking to them. Saliva contains billions of bacteria, many associated with 'rafts' or 'squames' of our dead cells. Researchers have shown that if you take spit and separate the liquid portion from the solid 'particulate' matter (comprising dead epithelial cells and associated bacteria), it is the latter that develops most of the smell.

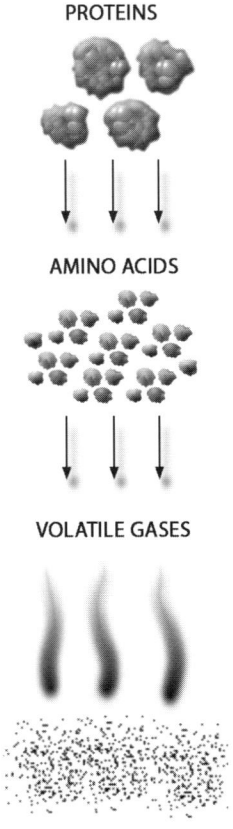
Bacteria do not only degrade the protein of our dead, peeling cells. Some can also be active between the teeth and below the gums destroying *live* human tissue. This contributes to smell exuding from the decay of our own gums. So if your gums ooze pus or bleed, people may smell your own body decaying (literally, as we speak). Perhaps the most important source of proteins, however, is postnasal drip. Postnasal drip (PND) gets stuck to the back of the tongue, where bacteria have a heyday putrefying it. We'll discuss that further on page 50. And finally, oral bacteria can also degrade the proteins in blood, saliva, and crevicular fluid (the fluid that slowly seeps from the gums).

Proteins that bacteria break down to produce individual amino acids

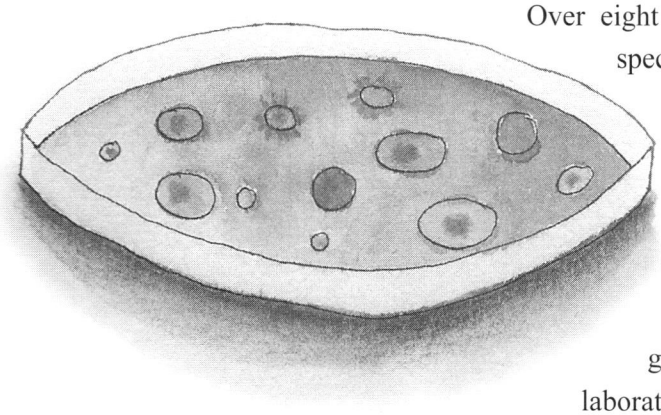
- Our own dead and peeling cells
- Food remnants
- Saliva
- Blood
- Postnasal drip

Amino acids are further broken down to yield bad breath

- Methionine ⟶ Methyl mercaptan
- Cysteine ⟶ Hydrogen sulfide
- Ornithine ⟶ Putrescine
- Lysine ⟶ Cadaverine
- Tryptophan ⟶ Indole, skatole



Which Individual Bacteria Cause Bad Breath?



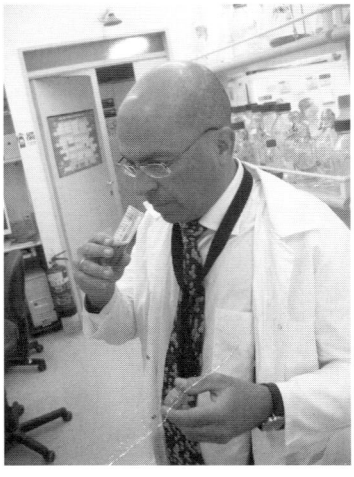
Over eight hundred different species of bacteria can colonize the mouth. When we isolate individual bacterial species from the tongue, teeth or gums and grow them in the laboratory (in test tubes or flasks), we learn quite a few things. Dozens of different types can produce foul odors. Most of them are so-called 'Gram-negative bacteria' (they get their name because they are not stained by the color test developed by Christian Gram in the 19th century). These include bacteria with names like *Fusobacterium*, *Haemophilus*, *Veillonella*, *Treponema*, *Prevotella*, and *Porphyromonas*. These kinds of oral bacteria, when grown in test tubes, make particularly foul odors. The type of smell depends on the conditions under which they grow. Significantly, when conditions are acidic, they do not produce foul odor.

For decades, researchers have believed that streptococci, a common group of bacteria that live in the mouth, are not involved in odor production. They are Gram-positive germs that are better adapted to grow on sugars as opposed to proteins. When grown individually in test tubes, they produce little odor. For years, we were perplexed by the observation that antibiotics that target Gram-positive microorganisms seem to reduce malodor as well. A postgraduate student in our laboratory, Dr. Nir Sterer, may have discovered the reason for this confusion. Many proteins in the mouth are actually glycoproteins, which means that they are composed not only of amino acids, but also of sugar molecules. These sugar molecules protect the proteins from degradation by the Gram-negative bacteria. As it turns out,

some Gram-positive bacteria produce enzymes such as β-galactosidase, which cleave off the sugar molecules that they can utilize. The 'bare' protein is then readily degraded by the odor-producing Gram-negative bacteria, a process that, as I mentioned earlier, creates foul odor. Thus it seems that oral malodor depends on cooperation between these types of bacteria.

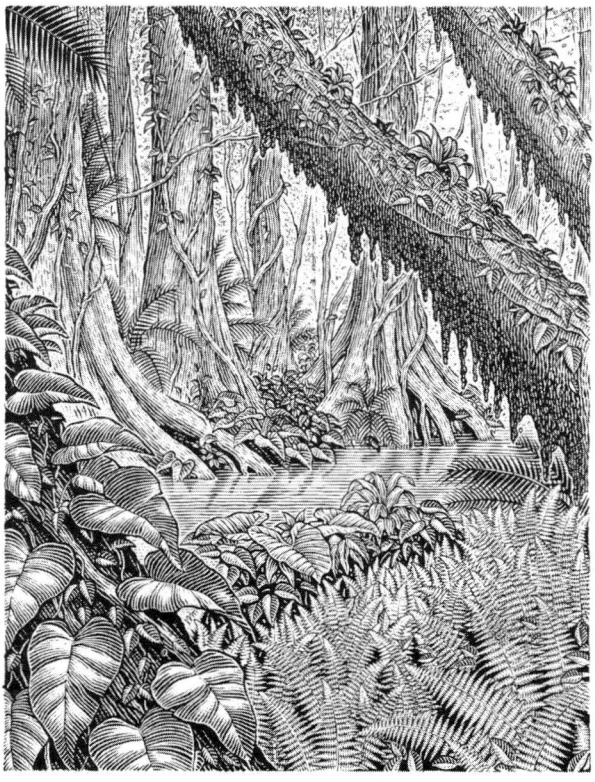
More recently, scientists at the State University of New York in Buffalo have found a microorganism, *Solobacterium moorei*, which appears to be associated with bad breath. This hard-to-cultivate Gram-positive bacterium is found in most people with bad breath and is absent in most people without bad breath.

These are all observations that could potentially help scientists develop new tests for bad breath and innovative cures. If we knew precisely which bacteria cause the odors for each individual, we could try to target specific agents that harm these bacteria in particular. Perhaps we could spare the 'protective bacteria' and injure just the harmful ones. Since several of the most odious bacteria are also the ones that we think cause gum disease, this would be particularly helpful. Unfortunately, we don't yet have agents that specifically target the smelly bacteria. Rather, most day-to-day antibacterial agents that we can use in the mouth seem to inhibit all the bacteria at more or less the same rate.



Oral Moisture and Bad Breath: The Mouth as a Tropical Rainforest for Bacteria

For bacteria to grow anywhere, they need a suitable environment. The first and most important requirement is *moisture*. Bacteria, like all living things, are made up largely of water, and need moist surroundings to grow and to produce smells. Most of our outer skin is very dry (except for the folds) and few bacteria live there. The mouth, in contrast, is relatively moist. The mouth is rich in proteins and other nutrients. Together with the available moisture, neutral pH, and comfortable temperature of about 35°C, the mouth is a relatively hospitable home to billions of bacteria.



Did you know?

The reason that dental plaque build up on our teeth is because we don't shed them. That's why it's so important to brush and floss.

At night, when we are sleeping, saliva flow is negligible, but our mouth is still moist enough for the germs to grow and release odors. After all, the air we exhale contains about 6% moisture. This is the time that most odor is produced. When we wake up in the morning, our breath is usually at its worst (so-called 'jungle mouth' or 'dragon mouth'). This is not the best time for French kissing.

During the daytime, the mouth is moist because of saliva. Saliva is an amazing body fluid. We need saliva in order to help chew food, swallow and talk. However, the moisture creates a breeding ground for bacteria. Saliva has compounds such as enzymes that control bacterial growth, and antibodies that bind and enmesh the microbes. It also has agents that compete with the bacteria for precious iron, which all organisms desperately

need. Saliva also helps wash billions of bacteria out of the mouth, into the stomach, where most cannot survive.

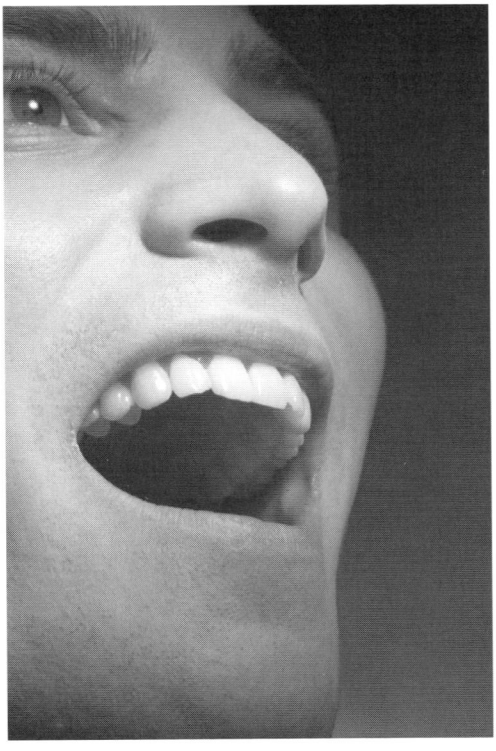
Oral bacteria desperately try to prevent being removed by sticking to the tissues in your mouth. The body helps overcome that by continually shedding the cells lining your tongue, cheeks and gums. Thus, saliva is continually washing away rafts of shedding cells, each with hundreds of bound bacteria. So the basic moisture of the mouth allows the bacteria to grow, while at the same time, the composition and flow of saliva help keep the bacteria at bay.

During the course of the day, saliva comes and goes. Interestingly, bad breath comes when saliva goes, and goes when saliva comes. As soon as we start thinking about breakfast, the saliva starts to flow, and the odor starts to decrease. And when we eat, the mechanical rubbing of the tongue and food with the other parts of the mouth does a decent cleaning job and that also has an odor-reducing effect. This is especially true if we eat rough foods that clean the tongue and help remove the bacterial layer and shed the outmost lining cells – but I'll discuss this in depth later (see page 116).

During the late morning, a few hours after we have eaten our breakfast, our mouth dries out again and the odor increases. Apparently, just as at night, bad breath arises during the daytime when the mouth is relatively dry and not enough saliva is flowing.

There is also the likelihood that the molecules causing the bad breath tend to leave the oral surfaces as they dry out, just as perfume evaporates on a drying wrist. Other factors, such as dry weather, mouth breathing, prolonged speech and nervousness can make our mouths even drier and smellier. This could be a good time to chew sugar-free gum for a couple of minutes to get the saliva flowing. This cycle repeats itself for all three meals. Between lunch and supper, and supper and bedtime, our breath levels start to creep up again.

More on Dry Mouth



Practically anything that reduces your saliva level puts you at risk for bad breath. This includes some 1,400 medications that may dry out your mouth. Other factors that precipitate dry mouth are mouth breathing, stress and anxiety, fasting, not drinking enough water, excessive exercising, talking a lot, and so on. Coffee and alcohol are suspect as well.

Some people have little or no saliva flow chronically. This may be due to *xerostomia*. Xerostomia can be caused by a variety of factors, including autoimmune disease and radiation therapy.

Xerostomia can cause difficulty in speech and eating. This mouth dryness results in a very acidic environment, which usually leads to dental caries. You may read that xerostomia causes bad breath as well. However, the opposite is probably the case. I once asked a leading authority, Dr. Leo Sreebny of the State University of New York, who told me that, based on his experience, xerostomics do not have elevated bad breath as compared with normal patients. This may be because xerostomics often have acidic conditions in their mouths which are not conducive to protein breakdown and odor production.

Where Inside the Mouth does the Odor Originate?

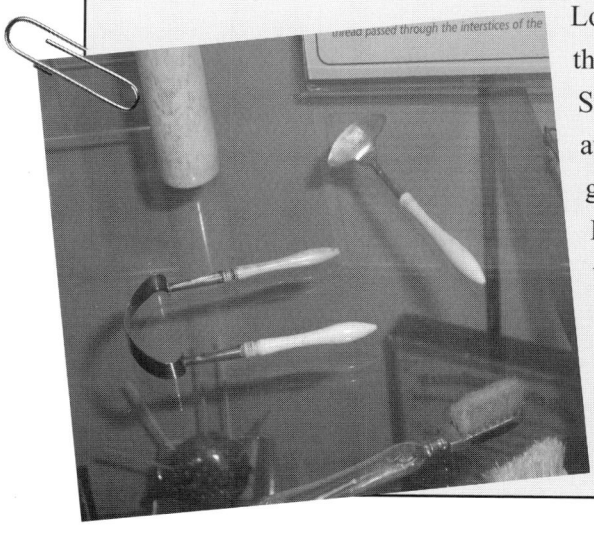
The Back of the Tongue

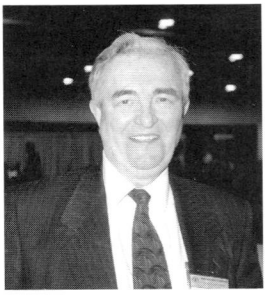
Interestingly, the most common source of oral malodor is not our teeth, as one might suppose, but rather our tongue! Here, I am not referring to the front area which rubs against our hard palate, but the very far back part towards your tonsils and throat.

Are you surprised? So was a dentist named G.L. Grapp, who checked the tongues of 500 patients. In 1933 he published a paper concluding that most bad breath comes from the back of the tongue. He found that the tongues of 90% of those he checked had a visible coating. Grapp showed that the posterior (back) two-thirds of the tongue were responsible for the odor by wiping that area with gauze, and then smelling it. Grapp suggested that bad breath arose from insufficient chewing of foods by modern man. He also designed a tongue cleaner and showed that breath improves when the very back of the tongue is cleaned.

Tongue cleaning – an ancient custom

If you happen to be walking down Wimpole Street in West London (parallel to the famous Harley St.), be sure to stop at no. 64 and try to get into the British Dental Association to have a look at their antique collection of European tongue cleaners.





The modern scientific pioneer of breath odor research, the late great Dr. Joseph Tonzetich, showed forty years ago that cleaning one's tongue reduces our sulfur emissions by 60-70%. Actually, tongue cleaning has been a big thing in India for hundreds, if not thousands of years (it's taught in their ancient Ayurveda medicine).

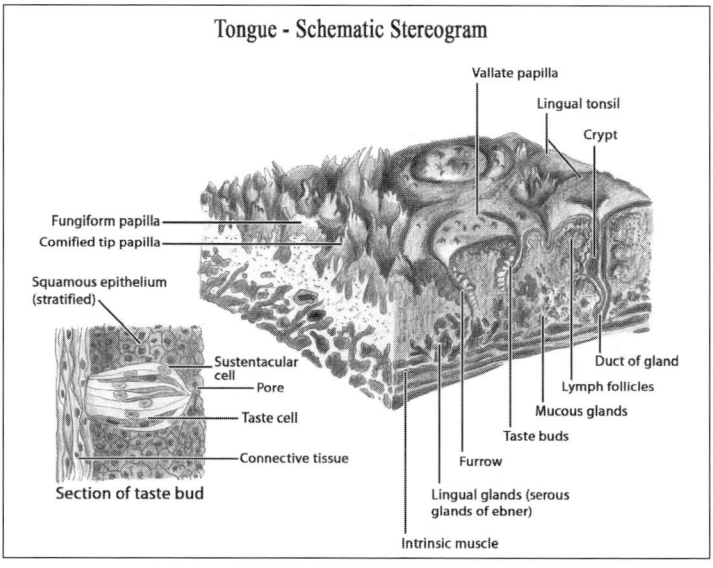
> I find it quite amusing that major dental corporations have recently incorporated a 'tongue cleaner' on the backside of some of their toothbrushes. I am not convinced that you can use them competently in that configuration, but marketing is marketing.

In the 1990s we initiated the 'wrist lick technique' as a method for self-assessment of bad breath. This is a simple test, in which a person sticks the tongue out as far as possible, licks the wrist, waits a few seconds for the excess saliva to dry, and then sniffs the residue. This is a simple way to smell the odor from the front part of the tongue. Odor judges can smell it relatively objectively. However, those of us worried about bad breath are appalled by the odor and tend to score it as twice as bad than it actually is. So it's a lousy yardstick for self-estimation. It does help illustrate the observation that our tongues do smell. And the farther back you go towards the throat, the more breath-like the odor gets. Don't count on it as an indication that your breath smells.

More on Tongues

We take our tongues for granted. Tongues, as the strongest muscle in our body, are necessary for eating and talking, two very important functions. They can also be used for kissing, playing the saxophone, whistling and many other pastimes, some of which I am not going to mention here.

Western (but not Eastern) medicine largely ignores the tongue. Tongues rarely get infected. Have you noticed that when you bite down on your tongue and it bleeds, within a day it's good as new? You don't need to apply iodine or a dressing, it just self heals, lickety-split. That's really amazing, since the tongue is a bacteria-infested organ. As I explained earlier, the top part of the tongue (what scientists call the tongue 'dorsum' or back) might seem to be smooth and flat, but it really isn't. If you look at a cross-section in a microscope you will see that it's like a shag carpet, convoluted, with lots of room for billions of microscopic bacteria to live deep inside the crevices. The top layer of cells sheds continuously.



This coating is often visible on our tongue. In rare cases, the coating signifies candidal infection or other medical problems. If you are concerned, you should ask your dentist. We are all born unique in different ways: size, color, and shape. Thus, it is not surprising that each of our tongues has a distinct shape and topography. Some tongues have more crevices than others. Some tongues are more coated than others. Some tongues harbor different populations of bacteria than others. Several scientific papers show that coated tongues may have more malodor, but then again - having a coated tongue does not necessarily mean that you have bad breath.

As Grapp showed, the area of the tongue that really causes most of the smell is farther back towards the throat. The very back part of the tongue is the 'wild west' of the mouth. The front part of the tongue rubs all day long against the hard palate above and mechanically cleans itself. It is also cleansed by saliva from adjacent glands. The back part of the tongue just sits there, out in the open, and is really cleaned only when some rough food rubs it, or when we clean it with a tongue cleaner. A former student and now colleague, Dr. Dov Abrams, once noticed that if you eat chocolate, several hours later you will still see its residue on the very back of your tongue. Saliva apparently does a very poor job of washing that back part of the tongue.

Postnasal Drip – A Major Culprit?

Based on my own experience, I would argue that the main cause of bad breath from the tongue is postnasal drip. Postnasal drip is the sticky mucus that runs backwards, down your throat. It is full of protein. When it runs down your throat, some of it can stick to the very back of your tongue. And though it may not smell when it arrives on the tongue, there are billions of bacteria on the tongue that can break the mucus down and produce foul odors. If postnasal drip hanging around on the tongue is a major cause of malodor, then we have some explaining to do. It turns out that most people secrete over a liter of postnasal drip every day. Yet only some people have

bad breath. What I think is that it's only the very sticky, gooey variety of postnasal drip that sticks around on the tongue. When we sample the very back of the tongue using the 'spoon test' (see later on page 93), we can often see a greenish yellow goop reminiscent of the viscous variety of postnasal drip.

Whatever the reasons, the very back of the tongue is the major source of bad breath in most people. So "Clean there or beware!" as we'll discuss later.

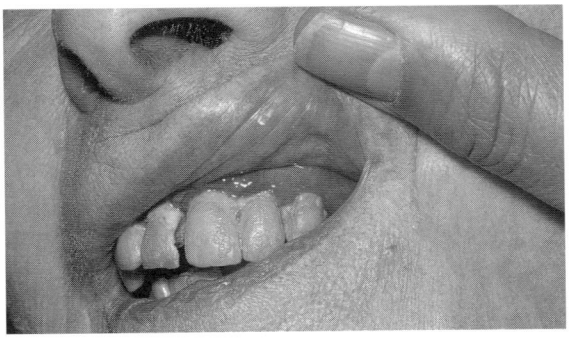
Again, the idea of postnasal drip as a major cause of bad breath is not something new: D.C. Hawxhurst suggested 'catarrh' as a cause of oral malodor back in 1873!

Teeth and Gums

Have you ever given much thought to your teeth? You should, because they are amazing. We get a set of teeth when we are young, they fall out, the tooth fairy comes (as I've written in several children's stories on teeth, all available for free at www.meltells.com), and then they are replaced by our permanent teeth. So from the age of about six, we come into possession of teeth that bite, chomp, chew, grind, and are so tough and resilient that they can last for thousands of years. Actually, anthropologists learn a lot about our ancestors from the wear and tear on teeth. Of course, if we eat sweets and starch, they can be exposed to acid-producing bacteria that can destroy them. But as I explained, acid and enamel decay do not cause bad breath (unless half your tooth is rotting).

Unfortunately, our gums are not as resilient as our teeth. That is because gums are 'soft tissue'. Our teeth stick out right through them. This causes a major 'breach' in the skin that envelops the body. Our skin covers our bones and our internal organs, and is a formidable barrier when intact. Bacteria and viruses cannot pass through the skin. But they can inflame adjacent tissues. When we don't brush our teeth carefully, biofilm builds up on our

teeth and irritates the adjacent gums. They swell, and more bacteria can then grow into the enlarged space between teeth and gums. If this process continues unabated, the inflamed tissue attaching the gums to the teeth starts to recede, and a 'periodontal pocket' starts to form. As the products of the bacteria (including the toxic gases they produce) increase, the gums recede further and the pockets grow and deepen. If the tissue continues to recede, the bony sockets holding the tooth in place start to disintegrate and recede. Eventually, the affected teeth become mobile and may end up falling out if left unattended.



Gum Disease

During the processes I just described, the inflamed pockets may bleed and discharge putrid exudate and even pus. In such instances, this may lead to particularly offensive breath. Periodontal disease may proceed slowly and insidiously within the pockets between teeth and gums. If these pockets are narrow, the bacteria within them may be producing a lot of putrid material and toxic gases, but only a very small portion of the odor escapes into the mouth. If the dentist sticks a probe into such a pocket, the odor may be overwhelming. Sometimes, existing periodontal pockets may go into a state of remission or relative inactivity. During such periods, less odor may be produced. These observations may help explain why some clinical research studies have not found a relationship between gum disease and bad breath (whereas others have).

Periodontal disease doesn't usually cause pain in the first stages, which is one of the reasons it tends to advance unchecked. Dentists often discover the problem when the patient comes in for other reasons (dental caries, for example). I once consulted a thirty year-old woman who complained of foul breath. She had advanced periodontal disease. She had never had

any tooth decay whatsoever, perhaps because of a well in her village with naturally high fluoride levels. She had never suffered any oral pain, and had never visited a dentist.

Whether or not the odor is coming from your gums, it is prudent to take care of them. In several studies, a relationship has been shown between periodontal disease and heart problems. Losing your teeth and being fitted with bridges, implants or dentures is no picnic, as many millions of patients can attest.

As Dr. Chris McCulloch taught me twenty years ago, healthy gums depend not only on your visit to your dentist, periodontist, and hygienist, but primarily on the care you take at home. Feel free to see our interview on this subject online at http://tinyurl.com/bbinterview. Proper brushing of your teeth usually depends on professional instruction, usually carried out by the hygienist. This is as important as having your teeth cleaned. The hygienist will also instruct you on proper daily flossing, which is a must. See further instructions on page 128. Results from our laboratory in Tel Aviv suggest that people who floss have less bad breath than those who do not. Results from Dr. McCulloch's laboratory at the University of Toronto showed that the odor on the floss is related to overall breath odor, and to the health of the gums as well.

Interestingly, in a Japanese study, people with periodontal disease had much more odorous tongues, with greater levels of coating, than those with no gum disease. We know that bacterial species from the gums can reside on the tongue. One possibility is that the tongue can serve as a reservoir for the bacteria associated with gum disease. Yet another good reason for gentle cleaning of the tongue surface !

If you are down in the mouth because of your dog's bad breath, the first place to look is the teeth and gums. Research has shown that doggy breath is also associated with poor oral hygiene and bad gums. (see also the section on mouth odor in pets – on page 76).

Other Sources of Bad Breath within the Mouth

Oral malodor can originate in other regions of the mouth. If there are any areas in between the teeth that allow for entrapment or impaction of food particles, bad breath can result. I have a faulty restoration which allows food to accumulate between two of my molars. If a piece of meat gets stuck and I forget to clean there properly, the smell can be formidable. Bacteria accumulate and cause odors in the mouth wherever they can. They hide beneath and around dental bridges, and infiltrate crowns. They can bring about oral abscesses which can also release putrid gases.

> Some people think that dental caries stink. Perhaps this is because when the dentist is drilling the cavity to prepare a filling, there is a foul odor. However this is unrelated to bad breath. Dental caries are not considered to contribute to bad breath, unless they are so large that they trap food debris, which can putrefy there.

The Tonsils

Most experts consider the tonsils to be a minor source of bad breath (perhaps causing malodor in 3-5 percent of cases). A minority of ear-nose-throat (ENT) specialists think that the tonsils have a higher impact in this area. Indeed, tonsils may smell upon strong mechanical squeezing, which leads some specialists to infer that they are the source of the odor. To what extent tonsils actually contribute to bad breath is a matter of controversy. Since the tonsils harbor great quantities of anaerobic bacteria, I am not surprised that they smell when pressed hard. There is the possibility that some odor escapes from the tonsils during swallowing (during which there is some contact between tonsils and tongue). However, if the tonsils contributed significantly to bad breath, one might expect some of the odor to come out of the nose as well. Nasal odor occurs in only about 5% of patients, and usually originates in the nasal passages themselves (see page 57).

Most experts would not recommend tonsillectomy (removal of tonsils) for bad breath complaints unless:

1. The odor is verified in the clinic.
2. All the other areas in the oral cavity have been completely ruled out as the source of odor.
3. Simpler treatments do not work (see part four of this book, page 112).
4. The breath problem is both significant and chronic.
5. There are other good medical reasons for operating.

As I explained earlier, I do have bad breath occasionally (like most people), yet my tonsils were removed when I was a child. Finally, there are no scientific studies showing that people who do have their tonsils suffer from bad breath to a greater extent than those who have undergone tonsillectomies.

Tonsilloliths

> *"In the fauces there sometimes occur little nodular bodies, made up of cheese-like matter, which constitutes the source of a peculiar fetor."*
>
> ***D.C. Hawxhurst, 1873***

I receive many e-mails each year from people around the world worried about bad breath. The most common question goes something like this:

> ***"I think I have bad breath because sometimes I cough up these little whitish stones. When I press them between my fingers they smell terrible. What are they?"***

These little whitish-yellowish stones (sometimes their consistency is more like a crumbly biscuit) are called tonsilloliths, or 'tonsil stones'. Unless they are extremely big, they cause only minor discomfort, and are not responsible for any significant diseases. For this reason, perhaps, many physicians and dentists aren't even aware of their existence. I originally thought that they were very rare. How wrong I was. Research carried out on Israeli army recruits suggests that some 5% of young adults have suffered from tonsil stones at one time or another during their youth.

Tonsilloliths are small deposits of calcified organic material (bacteria and their debris, in particular) that can accumulate in small cavities and convolutions (crypts) of the tonsils. These deposits break away from the tonsils, and are coughed up as little stones. Some people poke them out of the tonsils with pencils and other instruments (not a recommended procedure). Some advise trying a water spray, which would be less traumatic.

Although the tonsil stones do smell foul, they do not necessarily cause bad breath. However, they do lead patients to believe that their breath is as terrible as the stones themselves. Furthermore, since physicians and dentists often don't know what their patients are talking about when they

complain about this phenomenon, this makes matters worse. During most of their development, the tonsilloliths are inside the crypts and their odor isn't likely to escape. If you have them and you are worried that you have bad breath, you should consult your confidant. Ask your confidant to smell your breath before and after the stones pop out.

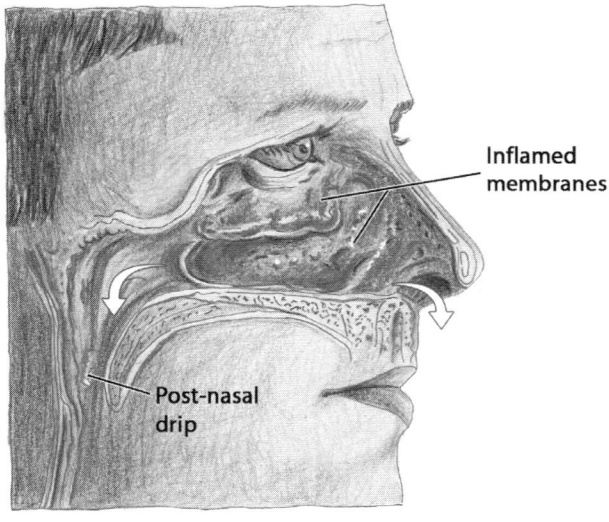
Again, there are several procedures available that seal the crypts in the tonsils where the stones develop, using laser equipment. These procedures are painful and result in loss of some of the tonsillar tissue. Since the stones themselves are usually unassociated with any disease, I wonder whether this procedure is called for unless great physical discomfort or emotional concern is involved, or if your confidant confirms that your breath is indeed bad when the stones are present, and fine when they are gone.

In summary, I do not believe that the tonsils are a major cause of bad breath. Having said that, I don't want to completely rule them out, either. It is possible, for example, that the postnasal drip, on the way to the tongue, passes over the tonsils, and collects microorganisms that contribute to the degradation and putrefaction of the postnasal drip on the tongue. After all, the tonsils and back of the tongue are in close proximity to one another and share bacteria every time you swallow.

Odor from the Nose

In adults, about 5% of the cases of the odor appear to be due from nasal causes. In such instances, the odor from the nose has a distinctive character, and is different from odor originating in the mouth. Nasal odor may come and go. In many cases, I have referred patients to ENT specialists who were not able to find anything amiss.

However, in other instances, nasal odor may be indicative of a nasal infection (e.g., sinusitis), or a problem affecting airflow or mucous secretions (e.g., polyps). In rare cases, craniofacial anomalies, such as cleft palate, may be involved. I have previously suggested that rhinoplasty (a.k.a.



'nose jobs') might also be a cause of nasal odor, but this is a conjecture and has not been followed up scientifically.

In children, foreign bodies placed up the nostrils may cause nasal odor that appears to seep from the entire body. I discuss this at length on page 65.

Other Rare Conditions

Many non-oral conditions, such as bronchial and lung infections, kidney failure, liver failure, various carcinomas, metabolic dysfunctions, and biochemical disorders can result in bad breath, but all these taken together account for all only a very small fraction of people not already diagnosed or hospitalized. In such instances, the odor appears to exit from both the mouth and the nose, and has a distinctive odor that can vary depending on the problem.

I am frequently asked about acetone breath in the case of diabetes. Many reviewers have cited acetone breath as a sign of this disease. Although acetone levels are somewhat raised among diabetics under supervision, it is rare that the concentrations can be detected by the nose. In less developed countries, among indigent populations, or in diabetic young adults away from home, acetone odor might still constitute a telltale sign for uncontrolled diabetes.

Similarly, some people talk about 'ketone odor' during fasting, although there is little research to back this up. People on a protein-rich diet may suffer from bad breath because of breakdown of the proteins in the mouth, and because of oral dryness. In both of these cases, the odor would primarily be coming from the mouth, rather than both mouth and nose (the latter would be indicative of odors exiting the body via the lungs).

Trimethylaminuria

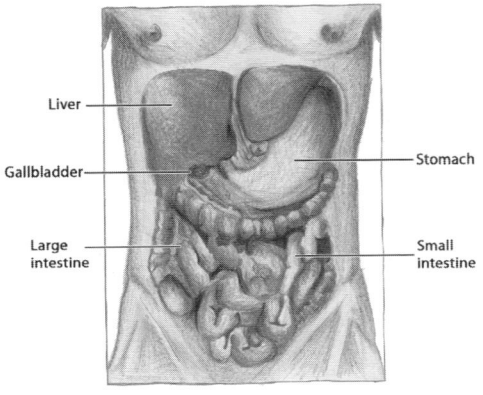
One rare metabolic condition that leads to a perception of foul fishy odor and/or taste is trimethylaminuria (TMAU), sometimes referred to as 'fish odor syndrome'. People with this condition are often aware of a fishy taste and/or odor, although the odor might be too weak to be confirmed by others. Trimethylamine is a fish-smelling molecule that we all produce in our bodies. However, it is normally oxidized and broken down by special enzymes. People with TMAU have reduced enzymatic ability to break down the trimethylamine so it builds up in sweat, saliva, and urine. Often the diagnosis involves collection and analysis of liters of urine, after the patient imbibes a choline-spiked cocktail.

Malodor in TMAU patients can be reduced by managing the diet to reduce the ingestion of foods that contain choline and carnitine, which are precursors of trimethylamine. A short list might include legumes, fish, eggs and certain kinds of meats.

If you are aware of a fishy odor coming from your armpits or saliva, you might indeed have this problem. Keep in mind, however, that it is so rare that I have yet to encounter a single patient with this syndrome. Again, the problem is that many physicians and dentists have never heard of it. People that do have TMAU often go to their family physician and complain about 'smelling like a fish'. The physicians usually do not take this complaint seriously, and recommend a psychologist. I have spoken over the phone with several patients with confirmed TMAU. They are very emotional about the problem, and it is understandable.

Bad Breath from the Stomach

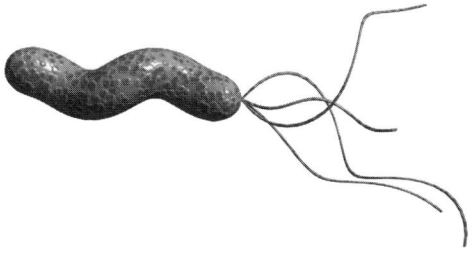
Unfortunately, many individuals (even some dentists and physicians) wrongly assume that the stomach is a common cause of bad breath. Bad breath almost never arises from the esophagus, stomach, or intestines. The esophagus is normally collapsed and closed. Each chunk of food (called a bolus) moves down the esophagus the way that a swallowed frog moves down a snake. Yes, an occasional belch may carry a bubble of stinky gas up from the stomach. The smell of a burp is indeed reminiscent of stomach contents, and differs from the typical smell of oral malodor. The rest of the time, the esophagus closes off the oral cavity from the stomach. The possibility of air escaping continuously from the stomach is remote.



You might have some bad breath after throwing up, but this passes when you clean your mouth. Some people may suffer from a terrible case of reflux that brings stomach or esophageal contents into your throat or mouth, but this is transient and exceedingly rare. In my entire career, I cannot recall more than one or two cases in which the stomach may have been involved in oral malodor.

Some physicians and gastroenterologists send their patients to tests, to check for the presence of *Helicobacter pylori (Hp)*. Hp are bacteria that thrive in acidic environments and, as such, infect various areas of the stomach and duodenum. Hp may be related to peptic ulcers and gastritis. However, the correlation between these bacteria and bad breath is tenuous.

What if the treatment for *Hp* does help?
If you do test positive for Hp your physician will probably prescribe antibiotics. These antibiotics enter your blood stream and saliva, suppressing the bacteria in your mouth that cause bad breath, as well. Thus, people being treated for Hp may experience an improvement in their breath, which usually lasts for a month or so. This improvement is probably due to the inhibition of oral bacteria by the antibiotics, rather than anything related to the stomach.

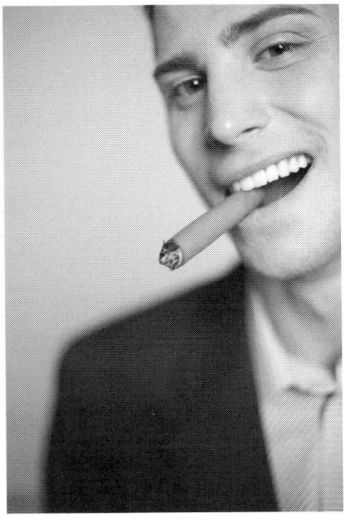


From my experience, when bad breath strikes, the stomach is the last place to look for an answer. In my opinion, a gastroenterologist who performs a gastroscopy (which involves sticking a tube all the way down into your stomach to see what is going on) when a patient complains solely of bad breath, is mistreating the patient. Plain and simple. Gastroenterologists should first send the patient to a dentist or an ENT specialist, and perform gastroscopy and *Helicobacter pylori* (Hp) testing only as a last resort.

Most scientific studies show no relationship between the stomach and bad breath. Some studies show an improvement after taking antibiotics against stomach ulcers, but as I have just explained, these very same antibiotics kill off the odor-causing bacteria in the mouth as well. The same odor-eliminating effect would result following antibiotic treatment for a urinary tract infection. No one would suspect the bladder as a cause for bad breath!

Finally, even if there is some remote connection between the stomach and the tongue or mouth, one would expect the odor to be reminiscent of stomach contents. It is not. In summary, unless you are bulimic or have serious problems with reflux or indigestion, the stomach should be the last, not the first place to look. Again, a confidant can be of great assistance in helping to ascertain the type of odor coming from your mouth. If it does not smell like acidic stomach contents, it is unlikely to be related to the stomach.

Smoking

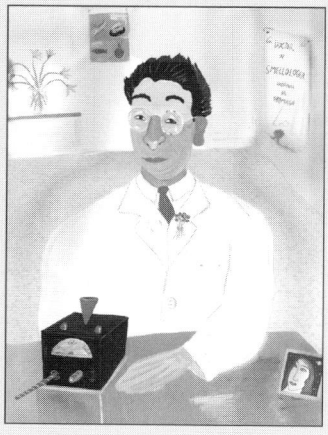


Smoking is an unhealthy habit. Ironically, for over a hundred years, people have smoked cigarettes to mask their bad breath, a practice that results in an unattractive odor in its own right. There are over 4,000 different types of molecules in cigarette smoke, some are quite harmful. Smoking has been shown in research as a risk factor for gum disease. This alone might constitute a link between smoking and bad breath. Smoking also exacerbates the accumulation of viscous awful-smelling postnasal drip on the tongue - a wicked combination indeed. Cigarette smoke lingers on hair, skin and clothing as well as the breath.

Bad breath from smoking was recognized by Dr. Joseph Howe in the late 19th century. He recommended chewing small pieces of cascarilla or cinnamon bark. I was once checking a woman in our clinic. Her breath had a definite odor of cigarettes, I told her. She insisted, however, that she didn't smoke at all. As it turned out, the patient was exposed to heavy second hand smoke.

I can smell a lot of things on a patient's breath. Food and drink as well as bacteria. It's all in a day's work.

One day, a famous children's book writer named Maira Kalman came to see me, as she was interested in writing a children's book on weird professions (The ensuing book, called "Chicken Soup, Boots" is sadly out of print). This is how I must have appeared to her!



"I can tell by my quivering proboscis," the doctor announces, "that you ate a gooey Gorgonzola three weeks ago. With a salted sesame cracker, correct? No need to respond, I'm always correct."

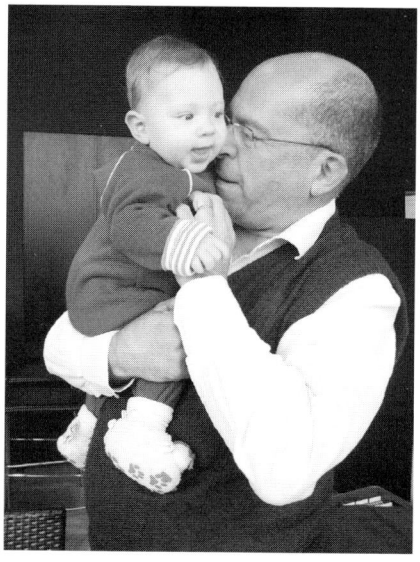
Bad Breath in Children

"...odours savours sweet

So hath thy breath, my dearest Thisbe dear"

A Midsummer Night's Dream
Act III, Scene 1

William Shakespeare



Babies generally have a sweet, pleasant breath. Certainly the little babies I have smelled have lovely

breath, indeed. I recently had the opportunity to smell the breath (and saliva) of Amitay. He is half a year old, toothless, and has wonderful breath. However, older children from the age of one or two can have bad breath. One type is the odor associated with the onset of streptococcal throat infections, a smell that mothers and physicians recognize better than anyone. The other kinds are similar to the same smells that adults have. Very young children can have odor from the back of their tongues, mainly because of accumulation of postnasal drip. When kids have a cold, they also breathe through their mouth, which dries out the mouth and exacerbates the situation. The back-of-the-tongue odor can be sampled and removed by cleaning the tongue with a small metal spoon, although this is more difficult to perform with youngsters. Young children can also have odor coming from dental plaque on their teeth. In most cases, proper brushing can take care of this – If you ask your dental hygienist, you will be told to clean your child's teeth right after their eruption with soft wet gauze, and to brush them with an extra-soft toothbrush from the age of one. Flossing is usually not necessary in small children, as they have gaps between their teeth. If it is required, it should be carried out in consultation with the child's dentist.

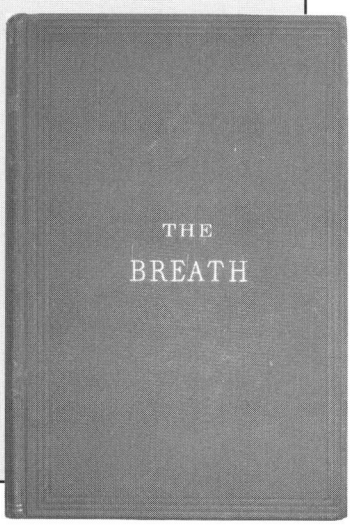
In any event, bad breath in children must be attended to. Kids can be cruel, and will make insulting remarks to any child that has any perceived problem, including bad breath. Some people will remember such insults their entire lives.

Foreign Bodies

A common past time of little children is sticking things up their nose. Luckily, most common items don't fit into the nostrils of a small child, but then again, some things do - bits of paper, pea and corn kernels, seeds, small batteries and even insects and snails are just some examples. If the material absorbs water, it quickly becomes full of bacteria and their stinky products, and begins to smell awful. This is complicated by the fact that with time, the smell appears to be coming from the entire body. This is because the children tend to take the purulent exudate running from their nostrils and spread it on their hands, hair, clothes, and so on. This has led some physicians and researchers to assume, wrongly of course, that the smelly molecules get into the bloodstream and exit through pores in the skin. The place to look is up the nostrils. This problem was recognized well over a century ago by Dr. Joseph Howe.

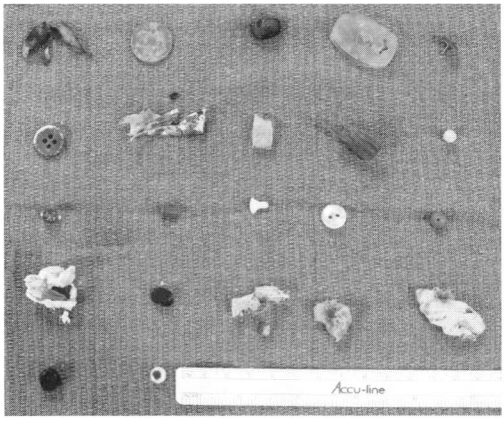
From Howe's book:

"Children of tender years frequently insert peas, beans, and foreign objects into the nasal cavities, which enlarge by the absorption of moisture, and, by and increase of pressure, cause great irritation. Peas and beans have been known to sprout in the nasal cavities after having remained there several days, giving rise to serious inflammation of the mucous membrane and spongy bones. The discharge takes place generally from the nostril in which the foreign body is located."



If the "foreign body" does not absorb water (such as a small plastic or metal item), the odor may take many years to develop. With time, the foreign body may become coated with calcified material. It may impede the proper flow of air through the nostrils, cause a low grade infection, and lead to an insidious odor which may or may not be overwhelming.

Recently, following a lecture to medical students, I was approached by Marshall Marcus, who told me that his father, Jeffrey Marcus, M.D., FACS (http://tinyurl.com/jmarcus) has a collection of such foreign bodies from the nose and ears. Here are several examples.



Foreign Bodies in Adults

In 1991 we had an interesting case of a 28 year old woman who complained of bad breath. She had three different kinds of odor. One was a slight oral odor. The second was cigarette odor. The third was a slight, but noticeable, peculiar odor from the nose itself. This prompted me to send her to Dr. G. Marshak, an outstanding ear-nose-throat specialist (ENT), head of a large department in a major local hospital. This was despite the fact that the patient had already been to see an ear-nose-throat specialist

in the US. Dr. Marshak soon detected the presence of a "foreign body" up her nose. When I subsequently asked him later, "why did you find it when other ENT specialists didn't?", his laconic reply was "I looked". The foreign body had to be removed with a chisel under general anesthesia at the hospital. The calcified foreign body turned out to be a child's bead, probably left up her nose some twenty-five years earlier. Interestingly, although the smell was slight, she complained of fierce odor, and was very upset that others, especially doctors, had trouble noticing it. Perhaps, since it was lodged in her nose, the concentration that she smelled was much higher than that noticed by others.

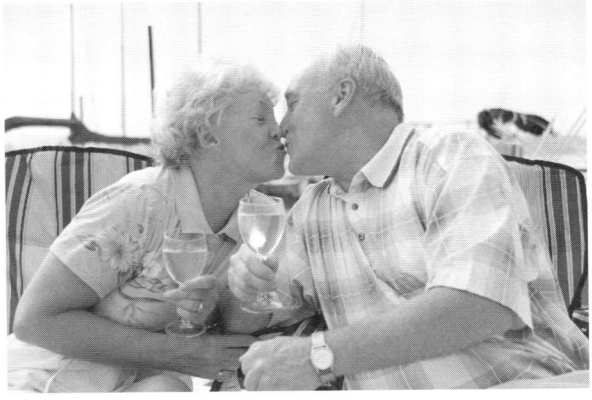
Following this incident, I read a few articles on odor resulting from other nasal foreign bodies. Thus, when I received a call from a concerned mother in November, 1992, I had a feeling that a similar issue was involved. The mother told me that her son, 19 years old and severely mentally handicapped, had suffered for the previous two months from a terrible odor from his entire body. As a result, he had been expelled from his special boarding home. She had taken him to see a variety of specialists including a dermatologist and allergologist. He had been put on a special diet and had lost considerable weight. He had also spent one entire morning at a major local hospital, including consultation with the ENT department. Over the phone, I told the woman that I had an inkling of what might be wrong, and that she should bring her son over for consultation.

The boy and his parents appeared around eight in the evening. It was instantly clear to me that he had stuffed something up his nose. One of his nostrils was red and running. The vile odor which enveloped him was definitely nasal in its character. I asked his mother whether she didn't suspect his nose as the source. "Yes", she answered, "actually one of my neighbors suggested that it might be, but we did spend that day at the hospital, and they took an x-ray of his nasal passages and didn't find anything." I asked her whether anybody had actually looked up his nose. "No", she answered, "they just looked at the x-ray".

The next day the boy was sent to another ENT specialist who removed a huge, unbearably foul blackened piece of paper tissue from his nose. The symptoms disappeared immediately, and the last I heard, the family was back to their routine. Since then I like to remind my medical students that plastic beads and tissue paper do not always show up on x-rays.

Bad Breath and Aging

In some research studies, bad breath tends to increase with age. This has to do with several factors that change as we grow older:



- Saliva flow tends to decrease in elderly patients, either naturally, or as the result of taking medications. There are hundreds of medications which inhibit saliva flow – such medications include anticholinergics, antidepressants, antihistamines and other prescription drugs. Anxiety and depression may also result in decreased saliva flow in the elderly.

- Oral diseases such as periodontal diseases can worsen over time, particularly if they are not attended to.

- Elderly people are sometimes not able to receive proper dental care. If they have partial or complete dentures, these can become odorous, as described below.

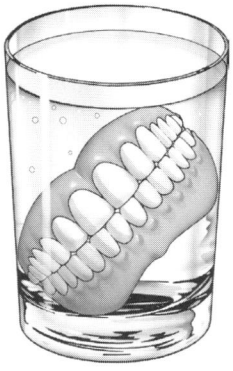
- Some elderly people prefer eating soft foods, since rough foods (which help clean the tongue) are harder to swallow. In such cases, proper cleansing of the tongue is not achieved, and oral malodor may result.

- Elderly people can sometimes have limited mechanical abilities, which can compromise their ability to practice proper oral hygiene, such as brushing, flossing, etc.

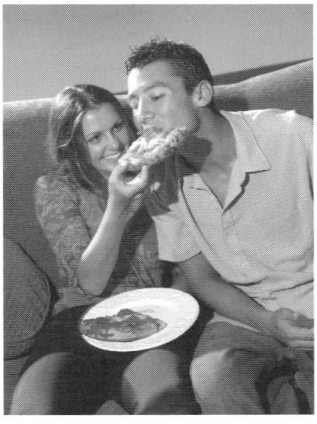
One of my first cases was a charming woman, about seventy years old, with a complaint of bad breath. She was despondent. Her grandchildren had refused to kiss her for the last ten years. Her dentist, Dr. A.Y. Kaufman asked me over to his clinic to meet her. I remember this meeting well, as it was one of my first cases! At first I was at a loss for what to do. I smelled her mouth. I asked her to remove her dentures. They had the same smell, particularly the inner part of the dentures that comes in contact with her toothless arch and palate. We put the dentures into a small plastic bag. After several minutes we could smell the same odor coming from the bag. In this manner, we were confident that her dentures were to blame. Dr. Kaufman proceeded to clean the dentures in an ultrasonic bath, and the odor immediately improved. No one had told her that her dentures were dirty. She left the clinic a very happy grandmother. This case helped prompt me to open up my first private breath consultation practice in 1988.

Denture Odor

With time, dentures often develop a characteristic smell. After all, they are porous pieces of plastic left in your mouth for years and years. They come in continual contact with our tissues, saliva, food, drink and billions of bacteria. Usually, it is not enough to just brush your dentures and stick them back in the mouth (although brushing is important). Unless your dentist advises otherwise, take your denture(s) out at night, and leave them soaking in an antiseptic solution (several commercial varieties are available) while you sleep. In this way, rather than having your dentures dry out in your mouth during the night, where they develop a crust of dried saliva, debris and bacteria, they are disinfected and deodorized. The difference is amazing.



Foods and Bad Breath



"The diet too should receive attention. ...Known polluters of the breath, such as beer, wine, sour-krout, and hard cider, may easily be entirely avoided."

D.C. Hawxhurst, 1873

Since foods rich in protein provide amino acids that bacteria break down into foul smelling gases, one should be particularly careful following meals with milk, cheese, soy products, meat, fish and eggs. If you can't brush and gargle after a meal, chew sugarless gum for a couple of minutes to wash away the food residues.

I do not know of any studies comparing the breath after eating meat vs. vegetables. However, there is one study from 2006 showing that 17 people on a two week vegetarian diet had better body odor than the same people eating a meat diet. My guess is that this would hold true for the breath as well. Or to paraphrase T.P. Eddy, it is better to smell of the garden rather than the slaughterhouse.

Onion and Garlic

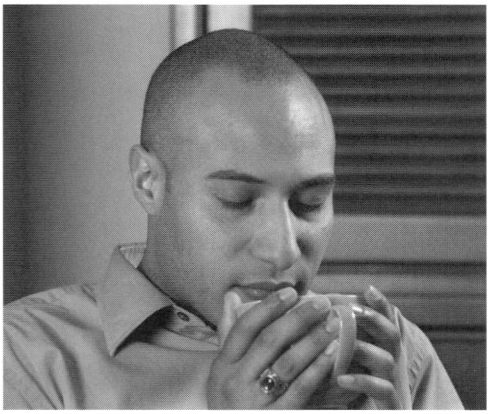
As we stated earlier, much of the odor that results from eating garlic and onions comes from the mouth itself, rather than the digestive system or lungs (there is a component from the lungs, but it is minor). So eat as much onion and garlic as you like, clean your mouth (and between your teeth) and chew sugarless gum for a few minutes to minimize the social consequences.

Alcohol

In a study we conducted recently in 2007, Tzachi Knaan examined 88 people who came for a routine dental checkup. The results suggested that alcohol consumption and obesity (see below) are risk factors for bad breath. Alcohol might dry the mouth out and that by itself may be the cause. Furthermore, some bacteria and yeast in the mouth can actually consume the alcohol and produce some odious by-products. Finally,

some of the products of the body's metabolism of alcohol smell and may exit from the lungs. Alcoholics tend to have a unique type of bad breath that has yet to be analyzed. As you have read on page 25, recent studies also show that alcohol-containing mouthwashes may cause an increased risk for cancer. Beyond the risk of suffering from bad breath, excessive drinking of alcohol is a serious health problem, damaging the liver and increasing the risk of cancer of the mouth and throat (as well as other types).

Coffee



Many people think that coffee causes bad breath. So do I, although there isn't that much scientific evidence to go on. First of all, coffee can dry out the mouth. Secondly, coffee has all kinds of aromatic chemicals that, when oxidized, don't smell very well. Finally, if you drink coffee with milk, the milk can be broken down to yield odors reminiscent of yoghurt, rancid butter and cows. On the other hand, initial research by Yael Gov in our laboratory suggests that coffee may contain molecules that actually reduce malodor, at least in the test tube. Clearly, this is a subject for future research.

Obesity and Bad Breath

You might be surprised to hear that there is another connection between food and bad breath. The research that showed a link between alcohol and bad breath (mentioned above) also found that being overweight carries a

risk of having bad breath. We found a statistical correlation between the body mass index (BMI) and bad breath. This means that the more a person weighs, the higher the risk of suffering from bad breath.

We still can't explain why overweight people might be more likely to have bad breath – it could be due to dietary habits, hygiene habits, metabolism or some other reason.

Bad Breath and the Sexes

Men and women are different in many ways. Thus it may not surprise you to know that this extends to the breath as well.

Several studies have shown that men have higher levels of bad breath than women, yet women tend to judge their own bad breath more harshly. The same also goes for a study we did on armpit (body) odor.

Women sometimes tend to have slightly higher levels of malodor during their menstrual period. Nobody knows the exact reason for this, but it might be associated with hormones that cause swelling of the gums during this time of month. So my suggestion to women is to practice even better oral hygiene during menstruation.

Women are, in general, more sensitive to smells (both good and bad) than men. This is even more pronounced during pregnancy. I recently interviewed a couple that

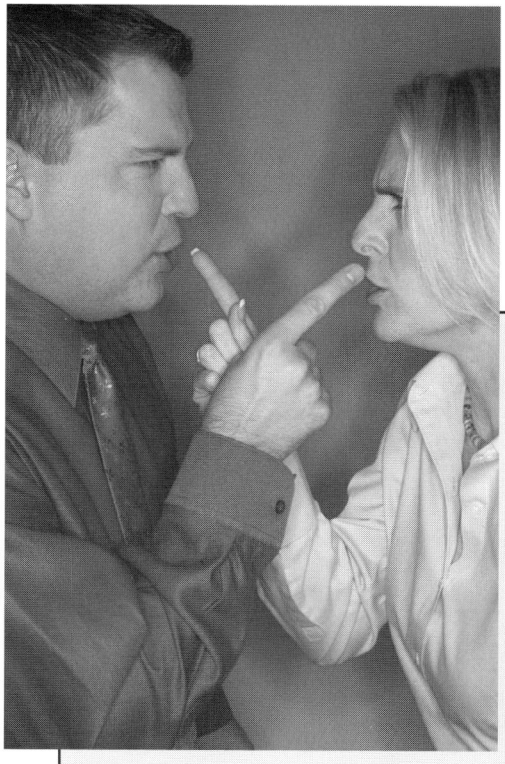
came to the clinic. The wife complained that her husband had recently developed bad breath. I asked if anything had changed in their life over the past few months. It turned out that the wife was pregnant. Probably, whatever slight odor the gentleman had was amplified by his supersensitive (hyperosmic), pregnant wife. So, guys, if you care for your dolls, smell well always, but smell especially well when they are with child.

> On one occasion, a husband and wife came together to see me in the clinic. I asked whom I was supposed to check. The wife said "Both of us." The wife had told her husband that he had a problem with his breath and that she was making an appointment for him to see me. "You think I have a problem?" he countered. "You yourself have had bad breath for the last twenty years!" So I ended up checking them both.

People vary in the manner to which they let unpleasant smells affect their lives. Perhaps you aren't enthralled with the body odor or breath of your husband or wife, but you go on living with them anyway. But bad personal odors can grind away at a relationship. On occasion, a peeved wife will bring her husband for a breath consultation. We smell the husband's mouth and ask the wife to do the same. We find that the husband has a low level of odor, yet his spouse proclaims: "Do you smell that? It's awful."

In rare cases, a spouse's malodor can become grounds for divorce. I was once asked to appear as a witness in such a divorce dispute. According to ancient Jewish law, if a man marries a woman, and finds out after the marriage that her breath stinks, not only can he divorce her summarily, but he is exempt from fulfilling the terms of the marriage contract (see page 79).

There is also the extreme case of a 48 year-old man from Indianapolis who reportedly murdered his wife in October, 1990 because of her breath.

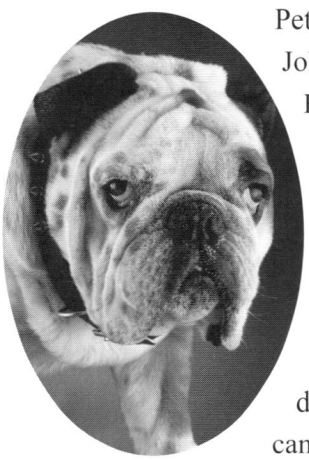


Here's a story from my former student and colleague, Dr. Amir Shuster, portraying how bad breath can be related to the battle of sexes: A woman in her thirties came to the clinic, complaining that her husband kept telling her she had bad breath. Dr. Shuster examined her thoroughly, but did not find any problem. So he asked her to schedule another appointment, but this time to bring her husband along. At the next consultation he examined the woman again, but still didn't find any problem. He asked the woman to sit outside in the waiting room and spoke with the husband in privacy. The truth was quickly revealed. Apparently, the wife demanded that her spouse fulfill his 'marital duties' a little more frequently than he was willing to. In order to cut down on intimacy, he complained that her breath was bad. All that the good doctor could do was recommend a marriage consultant.

> *"In rare cases, bad odors can take on a positive note. Thus I know of a case in which a girl was violently in love with an athlete, who suffered from a foul-smelling Ozena (putrid nasal infection). In the beginning this obnoxious odor was exceedingly painful to her, but her passion was so strong that not only did she become accustomed to it, but even missed and sought for it."*
>
> From Sexual Pathology; A study of derangements of the sexual instinct by Magnus Hirschfeld (translated by Jerome Gibbs), New York, Emerson Books, Inc., 1939.

Finally, in one of my university classes of hygienist students, there was a young woman who claimed that her boyfriend was crazy about her breath. He would ask her to speak aloud just so he could smell her wonderful breath. I asked whether I could partake, but was denied the privilege. So I can't tell you whether her breath was splendid or not.

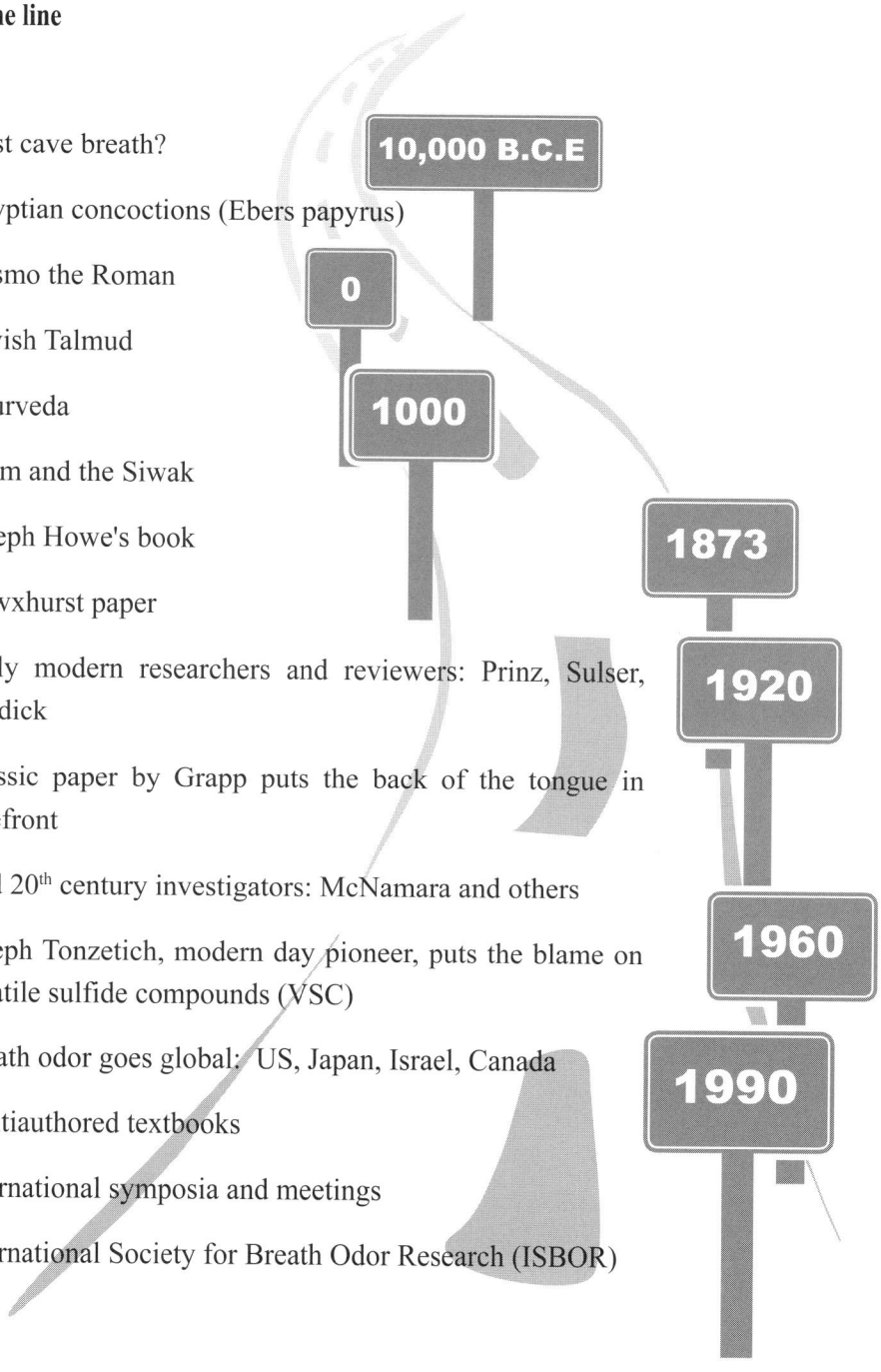
Mouth Odor in Dogs



Pet dogs can have terrible bad breath, or to quote John Irving ("A Prayer for Owen Meany," Corgi Books), "halitosis vile enough to give you visions of corpses uprooted from their graves." Breath odor in dogs is usually associated with gum disease. Since dogs don't brush their own teeth, you should. Sometimes dogs need to have their teeth cleaned professionally, just as we do. I also suspect that a diet of healthy, dry dog food promotes a better smelling mouth in a canine then the wet slop we often feed them.

History and Folklore

Time line



First cave breath?

Egyptian concoctions (Ebers papyrus)

Cosmo the Roman

Jewish Talmud

Ayurveda

Islam and the Siwak

Joseph Howe's book

Hawxhurst paper

Early modern researchers and reviewers: Prinz, Sulser, Fosdick

Classic paper by Grapp puts the back of the tongue in forefront

Mid 20th century investigators: McNamara and others

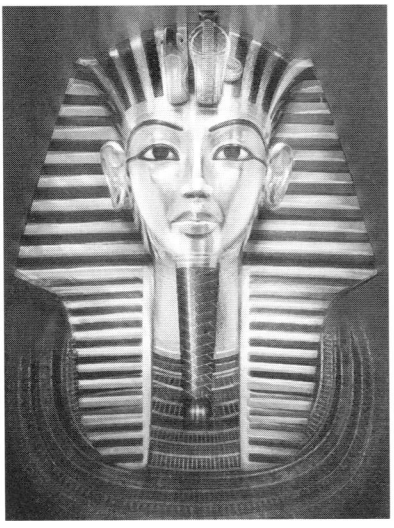
Joseph Tonzetich, modern day pioneer, puts the blame on volatile sulfide compounds (VSC)

Breath odor goes global: US, Japan, Israel, Canada

Multiauthored textbooks

International symposia and meetings

International Society for Breath Odor Research (ISBOR)



Bad breath has been around us for a very long time. Probably cavemen had bad breath. That we'll never know. But we do have evidence that there was bad breath in ancient Egypt, since the Ebers papyrus (stored at the University of Liepzig library), describes aromatic concoctions proposed to counter it. The Ebers papyrus dates back over 3,500 years!

In the first century, the Roman perfume entrepreneur *Cosmo* supposedly made a living pitching breath freshening pastilles to his fellow friends and countrymen. He was regarded as somewhat of a slippery cad by his fellow men, and may be a forerunner of modern television admen.

Gum Mastic Bush

Another ancient remedy for bad breath is gum mastic. Gum mastic is the resin of the *Pistacia lentiscus*, a bush that has flourished in Israel since Biblical times. Gum mastic has been chewed for reducing bad breath around the Mediterranean for thousands of years, and is still farmed (a backbreaking process) on the Greek island of Chios, off the shore of Turkey. Quite remarkably, this gum has antibacterial properties, and has been used for various medicinal and dental purposes over the centuries.

If you decide to buy some over the internet, please beware. The real, unadulterated resin comes in hard, brittle little pieces, is extremely expensive (several hundred dollars per kilo), and tastes like a pine tree.

However, you can buy palatable chewing gum containing a significant amount of gum mastic from the Chios Gum Mastic Growers Association.

Bad Breath in Ancient Judaism

Ancient Judaism regarded bad breath as a severe infliction, akin to having lost a limb, or suffering from leprosy. According to the Talmud, priests were not allowed to carry out holy duties in the Temple if they had bad breath. As I mentioned earlier, according to Jewish law, a man who marries a woman and subsequently discovers that she has bad breath, can summarily divorce her without even fulfilling the terms of the marriage contract (*ketuba*).

According to the Jewish Talmud, working with flax can give you bad breath. I found this perplexing until I was contacted by Nahum Ben Yehuda, a Talmudic textile historian from Bar Ilan University. He wrote me that "from antiquity and up until 1800 flax fibers were wetted by saliva in order to spin them into a finer yarn. According to the Talmud this damages the woman's lips and causes bad breath, and therefore a husband may not compel his wife to spin flax."

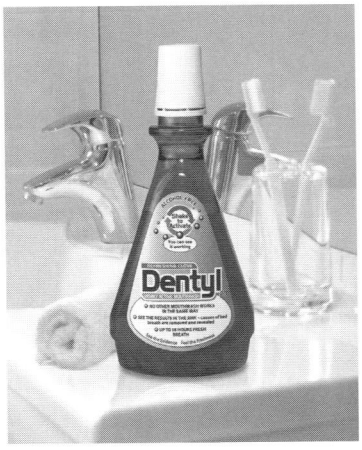
Specific vegetables are mentioned in the Talmud as bad breath risks, particularly raw peas and extensive consumption of lentils. Go know.

The Talmud suggests a variety of remedies for bad breath. One is the mastic chewing gum I described above. The Talmud states that while frivolous chewing of mastic is forbidden on the Sabbath, it is allowed as a cure for bad breath.

The Talmud also suggests aromatic spices (ginger and cinnamon) as oral fresheners. Other Talmudic cures for bad breath are somewhat more obscure. The sage Abbayae consulted an Arab, who suggested making a tar from heating unripe olive pits (what might be considered today to be a 'periodontal pack'), which he then stuck to his teeth. Yet another remedy

included the fat from goose wing feathers. Priests with bad breath were urged to chew on a type of pepper. Finally, exercise following meals and regular bowel movements were also recommended.

> I once interviewed an elderly man who thought that he had bad breath because as a youth he had indulged in copious self arousal. Someone told him that this would lead to bad breath later on in life. I subsequently learned that Maimonides, the great Jewish rabbi and physician of the Middle Ages, suggested that since sperm is the vital power of life, any man who is excessively and obsessively active in sexual behavior risks facing premature aging, fatigue, poor eyesight and bad breath. As far as I know, this hypothesis has yet to be supported by scientific experiments.



For me, the most poignant Talmudic revelation has to do with our own research (see a personal account on page 142). In the early 1980s we began developing a two-phase oil:water mouthwash now selling around the world as Dentyl pH™ (in Israel it is called Orbitol Triple Action). Our earliest laboratory formulations consisted of salt water and olive oil. Only later did we find out that a similar oil-water mouthwash was described in the Talmud some 1800 years ago! According to the Talmud, Rabbi Yohanan, one of the sages, suffered from bleeding gums. He consulted with an aristocratic woman (perhaps a healer) who advised him to use leavening water, salt and olive oil. Interestingly, the woman considered the formula to be proprietary, and only parted with it following the oath of the sage to keep it secret. Luckily, our own product (and patent protection) relies on the addition of

the antibacterial agent cetylpyridinium chloride to the oil:water mixture. Otherwise we might have been preempted by the prior art of a healer who lived almost 2,000 years ago!

Recently, I was interviewed by the "New Scientist" on my scientific career. I subsequently received the following e-mail from Prof. Paul Meara, Professor of Applied Linguistics, University of Wales Swansea.

"Re: your recent article in New Scientist, you might be interested to know that medieval Welsh Law allowed a wife to divorce the husband for bad breath. The source for this is: The Legal History of Wales, Thomas Glyn Watkin, UWP, 2007. p56.

"She (the wife) was entitled to repudiate him (the husband) for three adulteries, impotency, fetid breath or leprosy, or if he introduced a concubine into the matrimonial home." Interestingly. it doesn't seem to work the other way round..."

So apparently, if you're the man with the stinking belch, it doesn't pay to be Welsh.

Bad Breath and Islam

Islam also deals at length with bad breath and oral hygiene. There is the famous story that the prophet Muhammad once asked someone to leave the mosque because of his bad breath. Islam stresses the importance of hygiene, and good smells. A case in point is the *siwak* (sometimes spelled sewak, or miswak), a short stick which is regarded by Moslems as a holy instrument. By wetting and chewing or pounding on one of the ends, a kind of toothbrush is formed which can be used to clean both teeth and soft tissue. Siwaks are made from the aerial roots of certain trees and may contain antibacterial agents. Modern mint-flavored siwaks are also available.

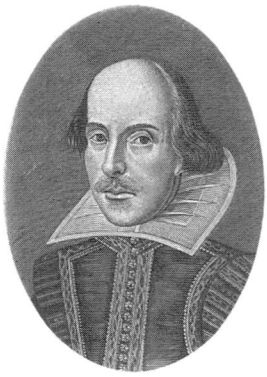
siwak

Bad breath is usually considered taboo in Islam, as it is in Judaism. One exception is bad breath due to fasting during the Ramadan, which according to Islamic teaching is considered by Allah to be more esteemed than the smell of roses.

My previous student and colleague, Dr. Iyas Natour, once sent me a story about a Sultan, whose breath was so terrible that even flies were afraid to come near his mouth. The Sultan once gave his wife an apple, and was surprised to find that she cut away the part he had eaten. When he inquired as to the reason, she leveled with him. He immediately got rid of her.

Bad Breath in the Performing Arts

William Shakespeare wrote about good and bad breath in his plays. I was once asked to give a seminar to dentists in Stratford upon Avon, his very birthplace. I gave a very difficult quiz on quotations on breath from the works of the Bard.



Here is one example:

"Nay, John, it will be stinking law for his breath stinks with eating toasted cheese"

King Henry VI 2, Act IV, Scene 7

Incredibly, one of the dentists in the audience appeared to know all the quotations from all the plays. As it turned out, he cheated. He had received telephone 'help' from his friend who was a Professor of Shakespearean Literature at the local university.

Movie lore has it that Clark Gable had a breath problem. According to the legend, Vivian Leigh was so put off by it that she didn't want to appear with him in "Gone with the Wind." Apparently, she really was gone with his wind.

Around the World

I've traveled to many far-off countries to attend scientific congresses and present lectures on oral malodor. Wherever I go, I find that people are concerned about bad breath, whether they call it halitosis, mauvaise haleine (French), or halitose (Portuguese). In English speaking countries, the Philippines lead the world in searching for "bad breath" on Google, with the US, South Africa and Canada close behind.

Different cultures have evolved different ways of dealing with bad breath. In Thailand, sufferers chew the peels of oversize guavas. Iraqis keep cloves between their teeth. Italians chew parsley. Indians chew fennel seeds. Brazilians cite cinnamon sticks as a folk remedy. At least one woman I met swears by raw dates. And almost all of us believe in the mouth freshening potential of mint (ironically, only a few varieties of mint have significant anti-odor properties).

Indeed, many plant extracts contain antibacterial molecules. These molecules are often oily and aromatic, and can be extracted as part of the 'essential oil' fraction. Essential oils are used in mouthrinses, toothpastes, and chewing gums, sometimes for their antibacterial effect, and sometimes for their aroma. Essential oil compounds that inhibit oral microorganisms include eugenol from clove, thymol from thyme, and eucalyptol from eucalyptus. Some of these can be purchased individually, but I would not recommend using them directly since at high concentrations they can cause irritation. We have found that a compound found in citrus fruits is highly active against oral malodor, and have even patented mixtures containing it, which we call 'Breathanol™'. The compound has been incorporated in a popular anti-odor chewing gum marketed locally and in several other products sold around the world.

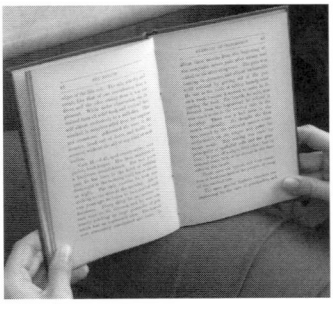
Chewing gum with Breathanol™

Traditional Chinese medicine suggests imbibing crushed eggshells in rice wine to treat bad breath; grapefruit is recommended

for alcohol breath; and for garlic odor, persimmon or red dates. On a visit to Singapore in 1995, a traditional Chinese pharmacist sold me a concoction of bark, leaves, and other dried items for relief of too much 'heatiness' (yang), which they believe is a major cause of bad breath. Singaporeans eat such delicacies as termite queens and durian fruit, and may need full-strength breath freshening following such odorous delicacies.

Scientific and Medical Literature

In the late eighteenth century, Dr. Joseph W. Howe wrote a medical textbook on bad breath, which went through four editions from 1874 to 1898 ("The Breath and the Diseases which give it a fetid odor with directions for treatment"; D. Appleton and Company) and which I have cited throughout this book. I first saw this rather rare tome at the library of the University of Toronto in 1990, and recently was able to purchase my own copy over the internet.



Dr. Howe was Professor of Clinical Surgery at Bellevue Hospital Medical College; Clinical Professor of Surgery at the University of New York; Visiting Surgeon to Charity Hospital, and Fellow of the New York Academy of Medicine, among other titles.

According to Dr. Howe (and some of our current research as well), bad breath is liable to occur at all periods of life, and is more common among menfolk.

"Yet how few of the afflicted persons detect the cause of their isolation, or recognize the barrier which effectually prevents the approach of those near and dear to them!

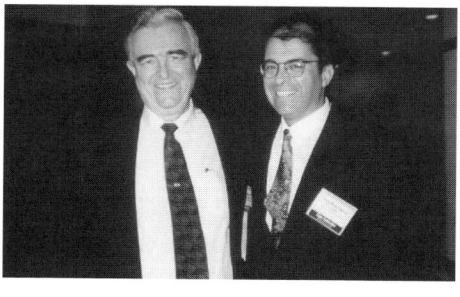
With the best intentions in the world, we rarely whisper a word of their disorder or suggest a source of relief. This false kindness - this demoralizing weakness - is universal."

The concoctions recommended by Dr. Howe include powdered cinnamon, cardamom, oil of nutmeg, rhubarb, myrrh and oil of peppermint, solution of carbolic acid (phenol, pretty toxic), charcoal cake, powdered coriander, sweet-flag (hallucinogenic at high concentrations), and leaves of partridge-berry (*Gaultheria procumbens*). Some of the compounds he suggested, such as arsenic and mercury, are now considered highly poisonous.

For tongue coating (which he considered related to digestive disorders), he did recommend scraping the tongue if it is coated, and washing the mouth with a solution of myrrh tincture and lavender water. "When the teeth and mucous membrane of the mouth are kept clean...the offensive odor of the breath will disappear."

Dr. Howe also discussed the possible contribution of diseases such as tuberculosis and advanced syphilis, which might have been more common and severe at the time.

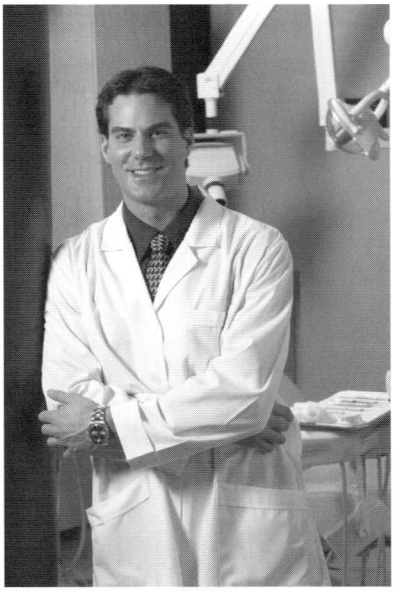
In the first half of the twentieth century, dental researchers such as Glenn F. Sulser and Leonard S. Fosdick began studying the breakdown of saliva and its relationship with oral malodor, periodontal disease and microorganisms. In the 1960s, Joseph Tonzetich, the modern day pioneer in this field, showed that volatile sulfide gases are an important component of bad breath, and can be measured using gas chromatography.



With Dr. Tonzetich in Vancouver

Part Three: Measurement and Diagnosis of Bad Breath

Diagnosing Bad Breath



I'm now going to share with you some techniques used by professionals to check for bad breath. Hopefully, this section will help point you in the right direction as far as diagnosis is concerned.

As I explained earlier (page 29), your confidant should be able to tell you whether the odor is coming mainly from your mouth or from your nose. If the odor comes from your mouth (this is the case in almost 90% of cases), you should make an appointment with a good, caring dentist. If your confidant tells you that the odor seems to be coming from your nose, then your family physician or ENT specialist is the person to see. In the rare cases in which the odor seems to come equally from the mouth and nose, see your family physician.

Dentists and physicians should, first and foremost, take a good detailed 'history'. They should ask you (and your confidant, if and when relevant) questions about why you think you have bad breath, when it started, and when it gets better or worse.

They should ask about and check for medical conditions that can affect the breath, such as:

1. Any pathologies of the oral cavity or pharynx, including teeth and periodontium, soft lesions, hard palate, throat and tonsils
2. Lack of good oral hygiene (for example, not flossing)
3. Postnasal drip (e.g., hay fever)
4. Mouth breathing
5. Eating and drinking habits
6. Diet
7. Stress
8. Past and current illnesses
9. Medications

If you are going to see your dentist or physician because you are worried about bad breath, be sure to prepare yourself accordingly. Don't wear any perfume, aftershave or other scented cosmetic products the day of your appointment. Don't smoke, drink alcohol or coffee, or eat any odoriferous foods (for example, those containing garlic, onion or spices). That way, if there is an intrinsic odor, the doctor is likely to detect it. If you are taking any antibiotics, postpone the appointment until a month has passed since you last took them.

Occasionally, physicians may suggest that the problem derives from the digestive system, and offer an endoscopy or a breath test for the presence of *Helicobacter pylori*. In this case, I suggest you share this book with them, point out pages 60-62, and tell them that modern research indicates that bad breath does not ordinarily come from the stomach. I have worked in dental and medical faculties for over 25 years, participated and lectured at dozens of medical conventions, and am constantly surprised to discover

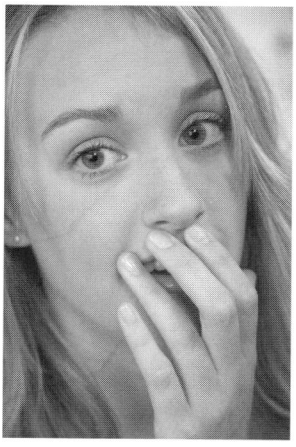
how many physicians and dentists have little knowledge regarding bad breath, and are many times misled by misconceptions and common errors. As I emphasized at the beginning of this book (page 17), this is the fault of the dental and medical faculties, not the doctors.

The Halimeter® and Other Testing Devices

If you visit a 'bad breath clinic', they may offer to test your breath using an instrument called the Halimeter®. This instrument, manufactured by Interscan Corporation of California, started out as a portable environmental volatile sulfide monitor (model 1170), which was modified slightly for breath measurement, based on research done in our laboratory in the 1980s (see also my personal account on page 152). The Halimeter® provides results which are statistically associated with bad breath. In other words, having a high score does not necessarily mean that you have bad breath, but rather the chances are greater. It is a mistake to think that if the level registered by the halimeter exceeds a certain cut-off value (say 120 ppb) that you necessarily have bad breath. The same probably goes for other newer instruments, such as the OralChroma™.

The Halimeter® is thus useful as an 'adjunct' instrument, alongside actual breath smelling. It is also useful for tracking improvements. This is because the levels of volatile sulfide levels usually decrease as treatment succeeds. Some clinics use additional laboratory testing. These might include enzymatic kits, such as Dr. Walter Loesche's "BANA" test, or the "OK to Kiss," which Dr. Nir Sterer and I have developed. These tests look for the presence of specific enzymes in saliva that are related to microbial activity associated with bad breath. Such techniques may provide helpful data, but again cannot be used as stand-alone tests to tell you whether or not you have bad breath and where it is coming from.

Human Measurement of Bad Breath: More on Why We Need Others to Smell Our Own Breath, and Why We Can't do it Ourselves?



Scientists have argued for decades about why we have so much trouble smelling our own breath. The commonly held opinion is that we become accustomed to our own breath. There are two ways in which we cease to recognize smells. One is adaptation – our neurons tire from constant exposure of the smell receptors to the same chemicals. The second is habituation. Our brain tends to ignore stimuli that are around all the time. When we enter a dentist's office we can smell the specific odor there. The dentists and their staff are 'habituated' to this odor since it is part and parcel of their work environment, just like the chairs and plants in the waiting room. This is why we notice the smell of other people's homes more than that of our own. After a few minutes, we become 'adapted' to the smell ourselves, as our receptors become saturated with the chemicals and cease responding.

If we exit the dental office for a few moments, this is sufficient time to reset the receptors and neurons, so when we go back in, we recognize that same smell again. Many scientists think that this is why we get have trouble smelling our own bad breath - we smell it on a continuous basis.

However, I don't buy that point of view. I think that there are two other explanations. The first is that we do not normally breathe in our own breath. When we talk, for example, the air leaves our mouth horizontally and spreads out. When we breathe in, the air enters the nose in a more vertical fashion. And, of course, since we do not breathe in and out at the same time, our exhaled air has managed to diffuse (spread out) greatly by the time we suck in our next breath (this is a good thing, otherwise we would be repeatedly breathing in the carbon dioxide we seek to expel).

What about the odor that you do smell when you cup your hands over your mouth and nose? Can you use this as an objective indication of how bad your breath is?

Probably not. When it comes to smelling ourselves, we have a lot of trouble being objective. We harbor preconceptions about a lot of things: how we look, how we sound. So it's not too surprising that we have preconceptions about how bad we smell. Together with Dr. Ilana Eli, we asked 52 subjects to cup their hands over their mouths and try to rate their bad breath. They were highly subjective. Their scores were not similar at all to the trained judge who smelled them, or to the laboratory measurements. We then asked them to lick their wrist and score the smell. Again, their results were twice as high as the odor judge, and did not correlate with his findings. As it turned out, the subjects each had a 'preconception' of how bad they thought their smell was.

When they scored their own mouth odor, their preconceptions guided their self-measurement, rather than the objective smell itself. These findings were published in the Journal of Dental Research in 1995.

That's why the person checking you has to actually smell your breath as well. Otherwise, there is no simple way of finding out. Your confidant should smell your mouth and nasal breath at the appointment as well. This will provide critical feedback: Is the odor at the time of the consultation similar, both in terms of the character (quality) of the odor, and its level (it might usually be worse or better) to your normal odor? After all, bad breath fluctuates over the course of the day.

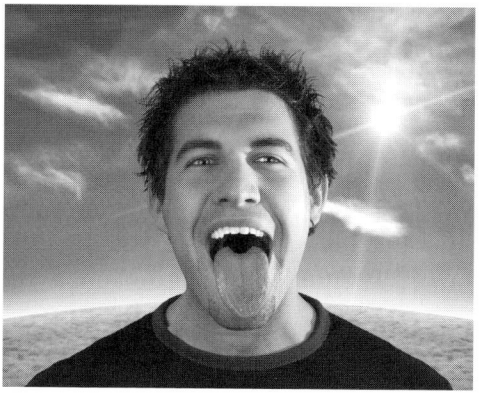
In the clinic, we smell and evaluate the breath odor of the patient in the following manner:

A. **Whole mouth odor:** we ask the patient to slowly breathe air out of the mouth, and we evaluate it from a distance of about four inches (ten centimeters). We grade the odor by its intensity and character.

B. **Whole mouth odor while speaking:** We ask the patient to count out loud from one to twenty and smell the odor from the mouth while the patient is speaking. We call this the "count-to-twenty test." This is sometimes very helpful, as bad breath is often most obvious during speech. This may be because of the movement of the various parts of the mouth during counting, which allows the odors to be released and waft out of the mouth. If the odor is coming mainly from the mouth, we can infer that the source of the odor is the mouth, or perhaps the throat.

Characterizing the type of odor depends on experience. This can only come from having smelled many mouths. The odor coming from the back of the tongue is usually very different from the odor coming from the nose, for example. Odorous dentures have their own unpleasant character. Odor from the gums has yet another 'personality'. The different kinds of odors may have to do with the type of bacteria involved and the kinds of proteins that they break down.

We measure the level of odor on a 'six point scale' that has been sometimes erroneously been called the "Rosenberg scale," perhaps because we have used it in many scientific articles. It actually predates our own work by almost ninety years!

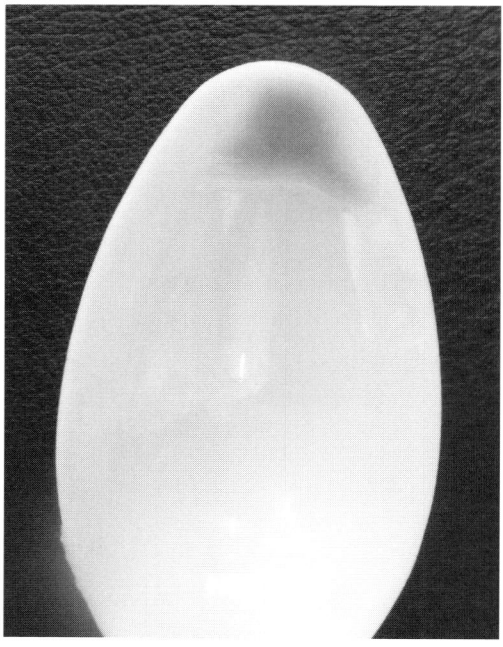


The odor scale:	
0	No odor whatsoever
1	Slight, barely noticeable odor (not likely to be a problem in everyday life)
2	Slight but noticeable odor (most researchers consider this the borderline or cutoff score)
3	Moderate odor (you don't want to be in this category)
4	Strong odor (you certainly don't want to be in this category)
5	Unbearably strong odor (luckily, few patients fit into this category. They can fill a room with odor pretty quickly).

C. Nasal odor: Once we've measured the level of overall odor coming from the mouth, we ask the patients to close their mouths and breathe out through their noses. While they're doing so, we evaluate the odor coming out of their nostrils. We pay special attention to the possibility that the nose is blocked. The type of odor originating in the upper nasal passages (which happens in about 5% of the cases) is usually distinct, slightly cheesy, and different from all oral odors that I know. There is some mixing of air between the mouth and the nose. Thus, in the case of strong mouth odor, there may be a minor component observable in the air exiting the nose and vice versa. In children this is particularly pronounced.

Sometimes, the odor comes from both the mouth and nose. This is a more common phenomenon in smokers and lovers of foods containing onions, garlic, cumin, etc. If the odor is uncommon and persistent, it may involve a rarer medical case and appropriate testing by qualified medical professionals is called for.

The Spoon Test and Other Oral Smell Tests



The spoon test is critical. It is what I call "the 2 cent test," because all it involves is a sturdy plastic spoon.

This is a test that is a little difficult to do by oneself, because it involves sampling the very back part of the tongue towards the throat. That, after all, is where most of the odor lurks.

The back-of-the-tongue odor can be evaluated by taking a plastic spoon in one hand, and asking the patient to stick out the tongue as far as possible and to hold his or her breath. The examiner then grasps the tip of the tongue with gauze and holds it, simultaneously using the spoon with the other hand to scoop up some of the mucus at the very back of the tongue dorsum towards the throat (about 12 cm from the tip of the adult tongue). Then, after waiting a few seconds, the examiner evaluates the odor and appearance of the discharge collected on the spoon. If discharge with odor is evident, then tongue cleaning, eating a healthy breakfast and gargling (see page 116) should handle the problem. In many cases a yellowish discharge is collected on the spoon and although there is no direct evidence, this discharge is probably postnasal drip. In subjects with hairy, coated tongues, the center of the tongue dorsum may also produce significant odor.

After smelling and scoring the spoon, we then have a closer look at the color and viscosity of the material scooped from the tongue. Does it look like postnasal drip? If so, that might be the culprit. We give the spoon to

the confidant to smell, asking whether this is the character of the overall odor. Often it is.

We also use dental floss to sample and smell the plaque originating between the teeth. We touch and smell the hard palate (with a glove, of course). If the patient has partial or complete dentures, we remove them from the mouth and smell them carefully as well.

The Emotional Aspects of Bad Breath

When Your Confidant Says "I Can't Smell a Thing"

Suppose that your confidant tells you that you ***don't*** have bad breath. Are you relieved?

If so, I am a happy camper. You can still continue reading the book, using the helpful tips that I provide for improving oral hygiene.

It might take some time for you to accept what your confidant has told you. If you have been preoccupied about having bad breath for years, this concern may not evaporate in a second. It might even take years. Please have a look at the story below, which describes the most important lesson I have learned over the past two decades.

Seven years ago I was planning a lecture trip to Philadelphia and had been contacted via e-mail by someone (we'll call her Daisy) who desperately wanted to meet me. I told her that I could not arrange a clinic to check her, but would be glad to meet her at my hotel, on the condition that she brought along a confidant. Daisy, a beautiful and charming young woman, finally found the courage to speak to her mother (after about a dozen years of worrying on her own) and they drove down together to see me. There was a lot of pent up emotion at that meeting. I explained to Daisy that sometimes, because of specific events in the past, we develop an exaggerated concern about a specific body trait (in her case, bad breath). At that meeting, she thought that her breath was offensive. Yet neither her mother nor I could detect any odor at all. I told her that after worrying for so many years, it would be difficult to accept this immediately, but perhaps over time she would realize that the problem was not as bad as she imagined. I gave her advice on proper oral hygiene and tongue cleaning, and we parted ways, with her mom promising to let Daisy know if she ever did notice that her breath was bad.

Six years went by. About a year ago I received an upbeat e-mail from Daisy that she "had gotten her life back." I phoned and asked her if she would take the time to tell her story for the benefit of others who might have similar problems. What a letter I received!! I've reprinted it below, with only very minor changes (mainly to protect her privacy).

It was 1989 the first time I heard those life changing words. In the middle of the public library, my boyfriend asked me if I had brushed my teeth. Of course I had, and in response I asked him why. He answered back that my breath smelled bad. I was extremely embarrassed and immediately put a piece of gum in my mouth. To complicate my situation, I was also bulimic and had been for about a year. I was concerned that he said my breath was bad but at that time I just assumed it was due to the fact that I had been vomiting

earlier that morning. I figured that I simply needed to brush my teeth especially well after forcing myself to throw up. Over the course of the next year my boyfriend brought up my same breath problem multiple times. I was now very worried because I knew that even though I was still bulimic, I was paying a lot of attention to the cleanliness of my mouth afterwards.

In 1991, I decided to make a dentist appointment to see if there could be a concern in my mouth. There was not. In fact, I was told that if all of his clients had my teeth that he would be out of business. I remember leaving his office just wishing he would have found something. My boyfriend, prior to my appointment, happened to come over while I was brushing my teeth in preparation. His only comment was that I never brush my teeth for him. I realized then that I could not spend any more time with someone that I was not comfortable around, so, we broke up.

I met someone else in 1992 but ended it quickly because I just did not feel comfortable around anyone. I was constantly concerned about my breath so I made an appointment with a doctor to have an endoscopy done. I wanted to see if anything could be found by the insertion of a tiny camera down my throat into my stomach. The results were normal but the doctor did smell odor from my mouth. He sent me to another specialist, who performed a few gastrointestinal tests. They first served me a piece of toast with scrambled egg that had been sprayed with a radioactive material. I then had to lie still for the next 10 hours as cameras monitored my digestion process. They found that it was taking my system 10-14 hours to digest an average meal. At that time the doctors weren't sure as to why my process was so slow and wanted to send me to another specialist. I should mention that I had no insurance and my funds were low. I did not see any more specialists at that time.

I made my own diagnosis; it was my bulimia and I had to stop. While working on trying to stop, I would go days at a time without vomiting and assume that my breath was better. I quickly lost hope of that when my boss one day handed me a tube of toothpaste and told me to use it. No words could ever explain my embarrassment. It took about a year to regain normalcy as far as a life without bulimia. To this day in 2007, I have not relapsed.

Against my ENT's (Ear, Nose, and Throat) advice, in 1992, I had my tonsils removed. I had read somewhere that sometimes tonsils can collect debris and cause odor and I wasn't taking any chances. I explained to my physician that I wanted them removed because I had bad breath and I didn't know what else to do. He told me that my tonsils looked healthy and that we were in a small room and he didn't notice a problem and he felt that I had normal breath. I told him that I was having my tonsils removed and that if he didn't feel comfortable with it that I would just get it done somewhere else. He agreed to remove them.

Although I was no longer bulimic and took very good care of my teeth, I still couldn't get myself comfortable around people. Did I still have bad breath? I was too embarrassed to talk to anyone about it or even be near people to get their reactions. I had spent so much time concerned about my breath and changing my life because of it that 'normal life' didn't seem possible for me. I continued avoiding people the best I could. I didn't show up for friend or family functions. I moved into an apartment by myself just for an easier way to avoid interactions. I felt very depressed and spent most of my nights in tears wondering if that was all life had for me and knowing that I would have to spend it all alone.

In 1996 I met a kind man. Just upon meeting him, or running into him rather, he asked me out to dinner. I didn't want to go but I am the type of person who will do about anything not to hurt someone else's feelings so I went. I assumed that I would never hear from him again once he realized I had bad breath. To my surprise, he kept calling and we kept going out. I realized at that point that he must have nasal problems to be so oblivious to my chronic halitosis. He mentioned to me once that I am a lot more talkative on the phone that I am in person. I was too embarrassed to tell him why. He was a very nice person and he made me feel comfortable around him by not mentioning my breath. I thought it would be my only chance to not be alone because of my 'problem' so a year later I married him.

Now that I was married and forced into the social circle, I had to come up with ideas on how I would handle being around people. I wouldn't ride in a car without the windows down. Inside the home, I kept candles lit. If I was outside talking with people, I would stand facing the breeze. When we would go to church or a dinner party I would insist that I was on the end of a row. (That way I could slightly have my head turned away from people when I exhaled). Many times I walked out of church because there was no end seat available. I wouldn't go anywhere without a purse full of mints and gum. I even have a crooked navel ring because of the fear of my breath. When I was having it put in, I was so afraid that I would sicken him since he was right in front of me that I turned myself around, my face looking behind me as he did it. I pretended that I was just afraid to watch. When he was finished and I turned back around, the placement was crooked since it had slightly shifted my waist area as well. Probably the most significant way I felt I protected myself from embarrassment was that I never open mouth kissed. Up to this point, I hadn't

kissed that way with anyone since 1990, my first boyfriend. It was now 2001 and I felt so depressed all of the time yet I pretended to everyone around me that I was the happiest person in the world. Behind closed doors I was still searching the internet to find ways to cure my halitosis. I decided to have another endoscopy and more gastrointestinal testing performed. The endoscopy was again normal and the gastrointestinal tests again showed a delay in digestion although not as severe. During my research on the net, I came across Professor Mel Rosenberg, who was doing and had already done much research on bad breath. I emailed him about my breath problem. It concerned me that he lived in Israel but somehow I was going to make a trip to see him. Fortunately for me, during a phone conversation with him, I found out that he was traveling to the U.S. This was my opportunity to meet him in person and to hopefully find my cure. One problem, it was going to be approximately a 10 hour driving trip. I couldn't go alone. I was going to have to confide in someone about my concerns. It was the most uncomfortable and embarrassing conversation that I ever had, with both my husband and my mom. My husband and my mom both told me that I did not have a breath problem and that I was going through too much for no reason. I was convinced that they just didn't want to hurt my feelings, besides, all of the people who had touched their nose or offered me gum or mints throughout my life had proven me right. My mom decided to go with me on my venture but said that it was simply because of her concern for me. She hadn't realized that I was in so much torment.

The day arrived, we took our trip, and I met Professor Rosenberg. This was a hard appointment in itself, and I remember initially tearing up. I had to go against everything I had trained

myself to do around people. He wanted me to breathe out closely into his face. He also took a spoon and ran it across my tongue, waited a few seconds, then smelled it. My mom also got to smell me and my spoon. Rosenberg then asked me when I felt I had bad breath. I replied that I believe it was pretty much all of the time. He then said something that I will never forget. He did not smell offensive odor. My first thought was how could this be? I always have halitosis plus my mom and I went out to eat an hour before meeting him and I had Chinese. I figured I would already smell and since I was meeting a professional for my problem I may as well be at my worst. I left my appointment feeling a bit relieved yet extremely confused. I began using the tongue cleaner that Prof. Rosenberg gave me right away. I had seen them before but never thought they would make such a difference in how your mouth feels. I hadn't realized just how important the cleaning of the tongue was.

I was so sure that my breath was rank all of the time. It was just too hard to believe that it wasn't. My mom and I openly talked about my breath when we returned home and she said she would honestly tell me if it was bad whenever we got together. It's just hard to believe that someone close to you would be honest about something like that. The turning point for me was thinking about Rosenberg. When I met him he was so genuinely concerned, you can see that he really wants to help people. I kept coming back in my mind to the thought that he would have told me the truth. He would have let me know if my breath were truly bad because he would have wanted to help me remedy it. It took months for me to sort out my feelings of the entire experience. I began taking things slowly just to see people's reactions. For example, I began riding in cars with my husband and friends without the windows down. When I wasn't offered gum or mints I started thinking that

maybe it was true. Little by little I began letting go of the strange behaviors I had trained myself to do while in the presence of another person.

I'm not sure when I was completely cured. It kind of crept up on me until one day I realized I wasn't doing any of the things I used to. I have no doubt that during my period of bulimia my breath was bad. I think anyone that threw up multiple times a day would find that to be true. Unfortunately, when my bulimia was over, my fear of bad breath wasn't. I wasted too many years of my life not being the person I was meant to be. I have had so many friends tell me that over the past several years that I have become more fun and outgoing than I used to be. They don't know what I was going through yet they can see that I am changed and my personality has blossomed. I feel so good about that.

Do I still worry about my breath? Of course, but it's a rarity for me to think about it. I believe that I have the breath of a 'normal' person. For the most part it's fine, but maybe now and then, due to garlic and such foods, something may be detected. I can't believe how much of my life I have wasted in fear. It's a wonderful feeling to be offered a mint or gum and to actually think about it. Do I want a piece or not? I have offered gum to people to be nice because I was having a piece. I wonder if those people thought I was saying their breath is bad. I no longer live in silence or hidden from the world. I am since newly married and as far as kissing my husband, yummy, need I say more? I have a daily routine. I brush my teeth and use my tongue scraper twice a day. I rinse with mouthwash and floss at night. I keep floss and gum in my purse in case I need it on occasion. I know I am taking care of myself and my teeth and gums so when it comes to my breath, I have no worries.

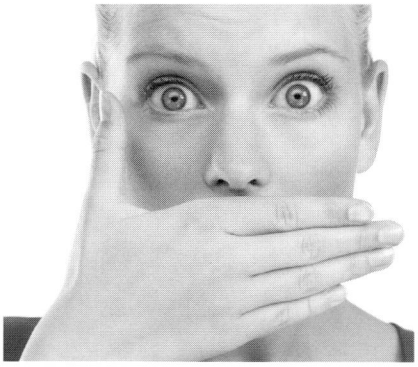
The letter is one of the most amazing I have ever received, and has had a great effect on my approach towards this concern. We learn that Daisy might have had some breath odor at one point as a result of being bulimic. But although she stopped being bulimic almost twenty years ago, the overwhelming concern persisted. Daisy's worry led her to:

1. Unnecessary, expensive, and potentially harmful medical procedures
2. An apparently unnecessary tonsillectomy
3. Social isolation and daily distress
4. A marriage of convenience
5. Not being emotionally able to share her pain with family or friends

Yet, despite her distress, Daisy was able to rebound and even share her story with the hope of helping others. A remarkable story.

These are the four steps on Daisy's road to recovery:

1. **Complete disbelief** - How could I possibly ***not*** have bad breath, after all these years of worry, avoiding people, medical procedures, concern, and noticing other's behavior?
2. **A small 'crack' in the wall of disbelief** - Why would the expert and confidant (in this case, her Mom and I) tell her that she had no bad breath, if indeed she did?
3. **The wall of disbelief opens** - A slow process of coming to terms with the possibility that the worry might be unjustified.
4. **Getting her life back** - The recognition that one has normal breath.



Daisy is not alone. According to research conducted by Murray Stein, Professor of Psychiatry at UCSD, there are some two million (!) people like Daisy in North America alone. These concerned individuals spend most of their waking hours trying to avoid any situation in which they are in danger of being smelled. They avoid being near anyone, and take a variety of precautions in case they are. Their handbags are full of chewing gum, mint, toothpaste, and floss. They brush and gargle incessantly. As in the case of Daisy, they may marry the wrong people for the wrong reason or refrain from dating anyone. I have heard additional stories of people having tonsils and even teeth removed fearing that they might be the source of bad breath.

Many concerned individuals are totally and constantly preoccupied about their breath. Sometimes this prevents them from many pursuits that would normally interest them. Some are bitter and vent their anger over the internet.

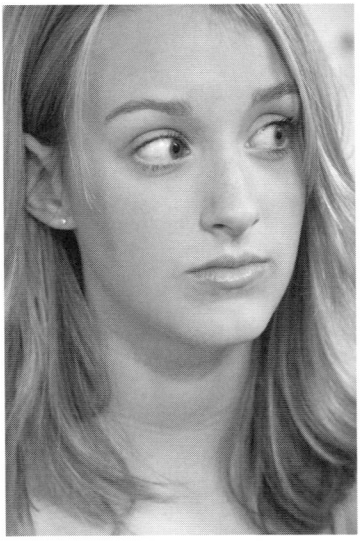
Cues and Clues Affecting Our Concern of Bad Breath

Most people who are concerned about their breath are too embarrassed to ask anyone whether they have a breath problem. Instead they look for signs based on other people's behavior. For example, if someone opens a window, they might take this as a sign that their breath is offensive (rather than trying to get some fresh air). If someone offers them a mint, they automatically assume that this is because of their halitosis (rather than generosity).

If someone rubs their nose in their presence, this might be interpreted as a sign that they are being smelled. I was once interviewing a woman in the

clinic when I rubbed my nose because it itched. "You see," she cried out, "you can smell my breath halfway across the room." Incidentally, she had no bad breath at all.

People who offer mints or chewing gum to others are usually just being polite. People who take a step back at parties might prefer to keep at a distance from everyone. They may even be self conscious about their own bad breath, and don't want *you* to smell *them*!



What other phenomena give rise to an exaggerated concern about having bad breath? First, as I described on page 56, some people (perhaps 5% of the population) have experienced *'tonsilloliths'*. Tonsilloliths are little crumbly masses that develop in little holes and folds in the palatine tonsils (crypts) and are intermittently expelled into the mouth. These 'stones' consist of calcified material, usually containing food particles, oral bacteria, dead white blood cells, and salivary secretions. Tonsilloliths smell very foul, especially when mashed between the fingers. Many people who have tonsilloliths automatically assume that their breath is as bad as the smell from the stones.

Here's the thing. Even though tonsilloliths smell really bad, they don't necessarily cause bad breath! I suppose that the reason for it is that when they are stuck within the crypts, the odors do not percolate out (I have the suspicion that the same phenomenon holds for subgingival plaque too). So even if you do have tonsilloliths, that doesn't necessarily mean that you have bad breath. I have seen patients who had tonsilloliths, even at the time they came for checkup, but had little or no bad breath. Again, the best way to figure this out is to ask somebody.

I recall meeting a medical professional on the way to a research conference. He told me that his wife, a dentist, was sure that she had awful breath (due to these little stones), even though he had never noticed that she had bad breath.

Here is a letter I received last month on this very subject. Please read it carefully, if you suffer from tonsilloliths:

"I am a 44 year old woman and have lived with the fear of having halitosis since I was around 13. I know all too well the fear of exhaling near people and the feeling that I am not as good as anyone else. I did ask two of my G.P.s when I was younger and as I got older, sought reassurance from various partners and although told I didn't and still don't have bad breath, the fear has lived with me despite 'good' oral hygiene, etc."

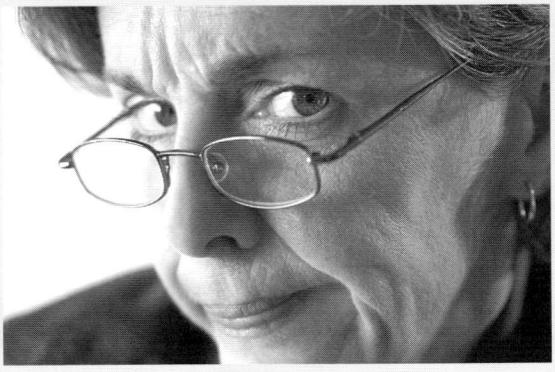
Here is another factor that leads people to assume that they have bad breath. Suppose that as a child one of your parents had halitosis. Now you are a grown up, and without even consciously making the connection, you infer that you have 'inherited' this condition. I once had a patient whose father was a clergyman in New York. When I asked her why she thought she had bad breath, after some pensive moments, she answered that she assumed that she had inherited it from her father. When I explained that this was a false assumption, she was relieved and subsequently brought in her father for a consultation. He had bad breath and didn't know - his daughter didn't have bad breath but was sure she did!

A further reason has to do with specific events in the distant past. Who doesn't remember insults hurled at them as a youngster? What if someone told you, in third grade, that your breath stinks? This insult, whether true or false, can last a lifetime. Remember Daisy's story of being told by her boyfriend in 1989. Even when she ceased being bulimic, her fear of having bad breath persisted for over fifteen years. So maybe you did have bad breath two, ten, twenty, thirty, or forty years ago. But even if someone told

you at one particular time that you had bad breath, it doesn't mean you have had it since then and always will. You have to ask.

Taste and Bad Breath

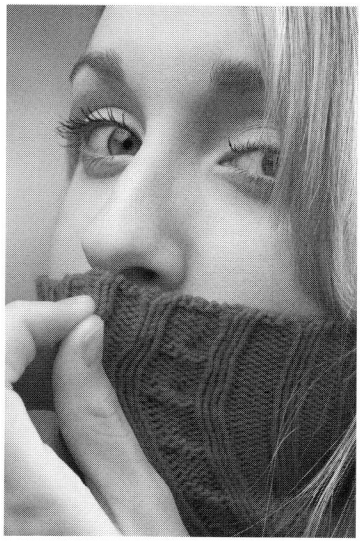
Some people think that they can taste their bad breath. However, research done in our malodor clinic in London did not uncover any link between bad taste and bad breath. In other words, people who complained of a bad taste in their mouth did not necessarily have bad breath, and people who didn't complain of a bad taste did not necessarily have good breath. During the day, it is rare that our mouth tastes 'good'. But if you are concerned, you may be noticing the taste more than others.



People who are very worried about bad breath often practice outstanding oral hygiene. Some concerned individuals get on with their lives despite their concern. Some even pursue highly successful careers. Among the concerned people I have interviewed were an international airline pilot, several CEOs of large companies, a government minister, a famous singer, and even dentists and physicians. Sometimes such individuals feel as if they have succeeded in spite of this debilitating concern.

I have had some limited success over the years in helping concerned people improve their life. I am successful when I persuade someone to

confront the concern. For many people, the concern of bad breath is terrifying. Summoning up the courage to ask anyone can seem almost life-threatening. So, anyone who can get up the nerve to ask someone whether there really is a problem has initiated the first and critical step. Individuals with a concern of bad breath who are able to overcome their initial reticence and confront family members or close friends may find out (to their initial disbelief) that no one else thinks there is a breath problem but them.



Once a concerned individual has started to appreciate that the possibility exists that there is little or no odor, there are several options. One is to compose a 'what if' list. In what ways will my life improve if it turns out that I really don't have a problem? Could I get a better job? Could I have better relationships? Might I feel less self-conscious? Other options include talking to a coach or psychologist, even over the phone. If required, some psychotherapy and, on occasion, medication are two avenues that might be of additional help.

Perhaps the reader is now thinking that I am talking from some academic pedestal. Yet I myself know what it is to be incapacitated for decades by an overbearing concern. We had, in grammar school, a child with a heart problem. When I began having palpitations as a teenager, I developed the notion that I had a bad heart as well. I abstained from various strenuous physical activities. I felt sorry for myself. At one point I stopped traveling. At the age of forty, my wife urged me to go to the country's top specialist to check. "Yes," said the expert, "the electric wiring of your heart is not normal." I felt vindicated, but the doctor went on. "Despite that, your heart is fine and you can carry out any regular physical activities." I was stupefied. I had 'wasted' all those years of worry and concern. I had misinterpreted

my 'symptoms' without looking into them. The past fifteen years of my life have been much better.

Most of us worry a bit about bad breath. But this worry is a minor one on our general worry list. So if your concern about halitosis is consuming your life, start by asking someone in your family. If the answer is "No, you don't have bad breath," start now and consider the possibility that they're right. Thank them profusely, and ask them to tell you if you they ever notice a problem. Don't waste your life worrying about an odor that might not be there.

I would like to cite a letter I received from Dr. Nir Sterer, who is both a dentist and oral microbiologist in our research laboratory, and has interviewed many individuals concerning their breath:

Overconcern about bad breath – a type of oral vertigo?

We all worry about our breath, some of us more than others, and some for no real reason. In some cases this constitutes a terrible burden, or to paraphrase Morgan Freeman's line in "The Shawshank Redemption": "Terrible thing, to live in fear." Having to concern yourself with this issue every single time you need to open your mouth is exhausting. The tragedy is that in fact, we sometimes worry even when we don't have bad breath.

This has always reminded me of a type of vertigo (you know, when a pilot is flying over sea in a pitch black night and his flight instruments indicate that he is upside down, yet he is convinced that he is straight up...). Of course, the analogy ends here, because we are not talking about a split second decision but many years of enduring constant concern.

Once people are convinced that they have bad breath, they will find assurances for this concern at every opportunity, simply because they are looking for them. Even the smallest most innocent

gesture or remark can serve as proof to affirm this conviction. How do you explain to people that they are wrong, when they're convinced they're right? This is a problem all 'breath caretakers' share. It is not an easy task, and one that requires a lot of patience and emotional effort. Treating halitosis and treating the concern of halitosis are two completely different things. Even if a person suffers from both, curing one will not resolve the other. It is useless to think that adopting a meticulous (and sometimes excessive) oral hygiene regime will help to regain confidence. On the contrary, this may sometime worsen the problem by causing deeper frustration and despair.

In order to break this vicious circle and resolve the 'oral vertigo', we must accept the rules of the game. There is only one rule really, and it is very simple: "we cannot sense our own breath." I'm sure there are a lot of theories explaining the fact why that is. However, the bottom line is that it doesn't really matter why – we simply can't.

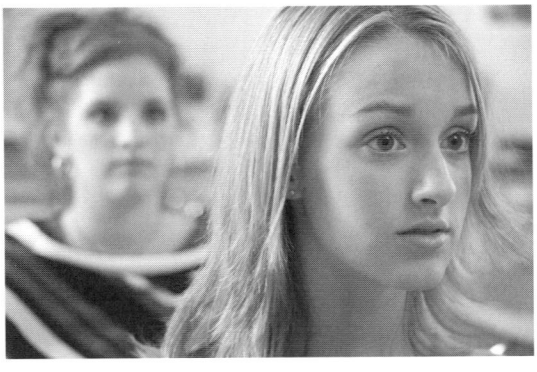
Resolving this 'vertigo' takes two major steps. Some of us may find the first step harder and others the second. Nevertheless, both steps are crucial and need to be done (no shortcuts or fast forwards!).

The first step is overcoming the embarrassment and asking a close friend or family member if he or she ever noticed anything. For some this will be the equivalent of singing in public (or running naked down the street). Some psychologists call it 'shame attack'; the name is not important but the action is. Just take a deep breath and do it, there is no other way.

The second step is accepting the answer that they give you even though it might be the complete opposite of what you are used to

thinking. We all like to have control and rely on ourselves. That is why emotionally it is very hard to let go. This often reminds me of the trust exercise (when you close your eyes and fall back, relying on your partner to catch you); letting go is not easy. That is why it is so important to choose the right person to ask. By "right" I mean right for you. This has to be a person that you trust and whose opinion you value. For some of us, asking three or four different people may be more convincing.

It all boils down to a simple question that you need to ask (Is my breath OK?). No amount of tongue cleaning, flossing, etc., will help you regain your confidence as much as one simple answer (Yes, it's fine!).



To sum up, if your confidant tells you that yes, you do have bad breath, there likely is an objective problem. In that case, go through Parts Two and Four of this book and I'll try to help you fix it. If your confidant tells you that there is no discernable smell, then perhaps you are among the millions of concerned individuals I have been talking about. Try to answer the following questions:

1. Do you worry excessively and/or continuously that you might have bad breath, even after your confidant has told you that you don't have a problem?

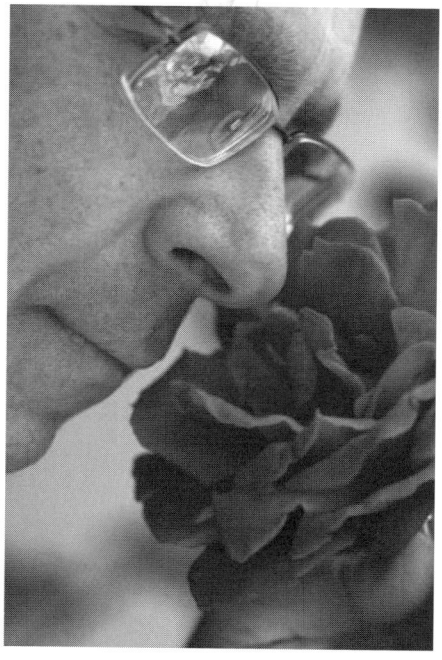
2. Do you watch other people for signs that they smell your breath? This may include seeing others rub their noses, open windows, turn their

heads in the other direction, take a step back when speaking to you, or offer you a mint?

3. Do you refrain from normal activities as a result of your perceived bad breath?

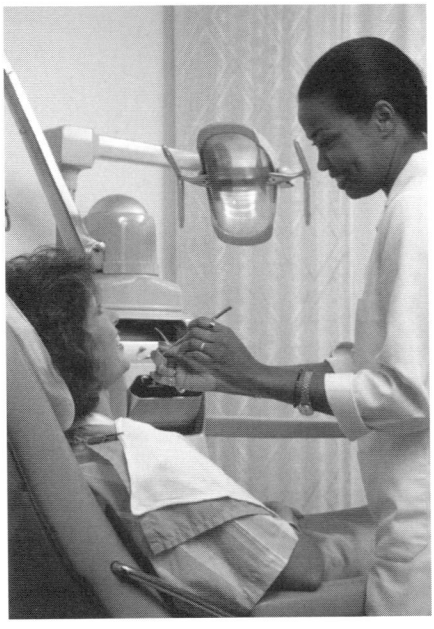
4. Are you preoccupied with your own oral hygiene all day long?

If you answered yes to any of these questions, please go over Daisy's letter again. Make sure you aren't wasting your precious time, energy and health, worrying about a problem you may not have. You might eventually start to consider the possibility, however startling at first, that your breath is BETTER, not worse, than that of other people!



Photographer: Maya Hed

Part Four: Treatment



You have now reached Part Four of this book. You want to improve your breath and build additional confidence, trying to make sure that you are doing the right things to prevent you from ever having it.

Whatever you do, don't kiss your confidant goodbye. You will still need him or her for this recovery stage. This is because we are also lousy judges at which treatments work for us and which don't.

My research colleagues and I have tested people's ability to detect improvements in their breath following treatment. Some of the studies were done in Israel, others in Canada. What we found was astounding. In Canada, we asked people to rate their improvement following a week of gargling with a very strong chlorhexidine mouthrinse (we even needed approval of the Canadian Ministry of Health to use the mouthrinse). The improvements were noticed both by the odor judges and the scientific tests, but the participants themselves did not detect the benefit and were largely dissatisfied. In Israel, we gave participants instructions on how to improve their bad breath, and called them back after one year to determine what changes had occurred. We found that their hygiene habits had improved, and that there were significant improvements in their breath odor. Yet the participants mistakenly thought that there were no improvements at all.

As I said, we are lousy judges when it comes to sensing any improvement in our breath odor. So hang on to that confidant!!

Treatment Strategies

Over the course of the past two decades, experience has taught me that there are several treatment concepts and strategies that help most people. I will concentrate on those, but mention others as well. As with other medical conditions, proper diagnosis is the key to successful treatment. If your problem is a faulty dental restoration with festering bacteria, no amount of tongue cleaning is going to set it right. It is advised, of course, that you visit your dental hygienist and dentist to make sure nothing is wrong with your teeth and gums.

Also, please ask your confidant whether your breath continues to get better as you follow these strategies.

Treatment Concept One: Clean Your Tongue

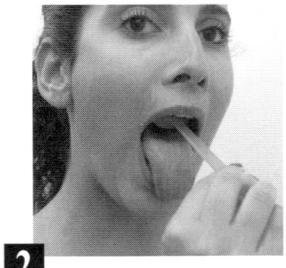
As mentioned earlier, most cases of bad breath stem from the very back of the tongue. This is the part of the tongue that is driest and hardest to clean.

In most people a clean tongue means 'better breath', and a dirty tongue means 'better beware'. Choose from three strategies. Try practicing all three.

How to Use a Tongue Scraper

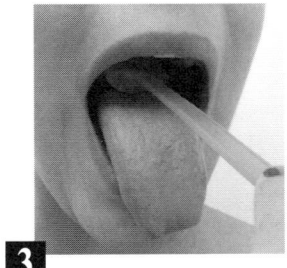
1

It is advised to use a designated smooth plastic tongue scraper, that can help you sweep the innermost part of the back of your tongue.



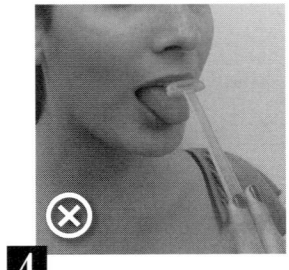
2

Extend your tongue and gently clean the back of it, cleaning in inside-out motions.



3

Make sure you clean your tongue gently, without harming it and without causing gag reflex.



4

Do not just clean the front of your tongue – that won't help you avoid bad breath!

courtesy of Dr. Alon Amit, DMD

First Strategy: Mechanical Tongue Cleaning

This is a difficult method to perform correctly. To make things as simple as possible, choose a flexible one-piece plastic tongue cleaner. Metal tongue cleaners can scratch and damage the tongue, and might be cold and unpleasant. Choose a tongue cleaner which is thin, so that it doesn't contact the soft palate (that can really make you gag). Avoid brittle plastic tongue cleaners that might break. Clean gently and do not traumatize the tongue.

Remember that the idea is to gently sweep the mucus and debris off the very back of the tongue. It is unwise to scratch, manicure or otherwise plough into the sensitive tongue surface. Try to find the most convenient and efficacious time to clean the tongue. Breathe through your nose and relax as you perform deep tongue cleaning. Don't go in too far the first time. Gently sweep the mucus and debris outwards towards the lips. Repeat a few times. Go in a little farther every time until you are comfortable going all the way back where the odor lurks.

Some people have more gagging reflex after brushing their teeth, while other feel more comfortable cleaning their tongue after they have already brushed. Some people have less gagging reflex if they scatter some salt under their tongue (maybe because they salivate more this way or because it makes them concentrate on something other than the cleaning procedure). Either way - you need to try and see what technique suits you best, because it has to be as comfortable as possible. In most cases, gagging reflex goes away with time and tongue cleaning becomes a habit. Gentle but deep tongue cleaning should be performed once or twice a day.

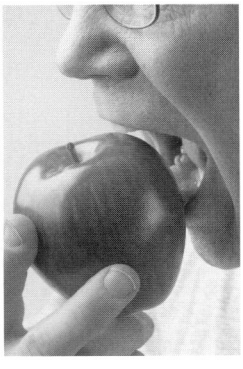
If you think that you have a major problem with postnasal drip (see page 50), you might consult your physician. There are medications that control such secretions, but as with other types of medication, they have undesirable side effects. Some ENT specialists recommend nasal sprays with saline solution, but I am not yet convinced that this is worthwhile. And of course, if you are even more intrepid, there are those who 'snort' saline into their nose and spit it out their mouth. If you master that technique,

be sure to let me know! If you have difficulty in finding a good tongue cleaner, you are welcome to try the one we developed. Please check out its availability at www.smellwell.com

Second Strategy - Clean Your Tongue with a Healthy Breakfast

Odor is worst when you wake up in the morning. A healthy breakfast cleans the tongue and the rest of the mouth, as well. In order to optimize the cleaning process, the food should be relatively rough, as it was thousands of years ago, before the invention of refined flour and mashed potatoes. Foods such as fresh salad (including carrots), nuts, fruits, scrambled eggs, olives, porridge and rough bread are particularly advised. They are also healthy, which is a bonus in itself, particular since doctors and dieticians tell us that breakfast is the most important meal of the day. This may sound a little ridiculous at first, but it appears to work wonders. Research has shown that eating reduces the level of volatile sulfides in the breath by about 70%. Combine the mechanical cleaning of the food with the additional effect of increased saliva flow that accompanies mastication and you get fresher breath.

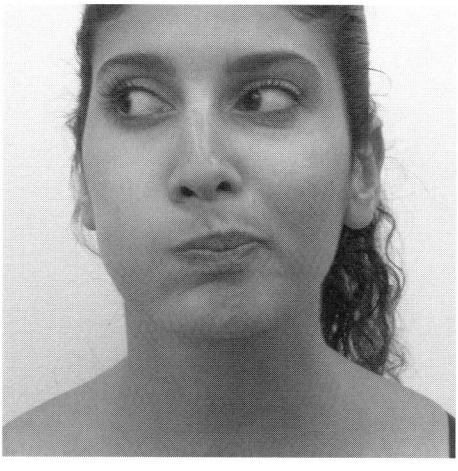
It may be advisable to eat small amounts of rough food, such as a carrot or a granola bar, once every few hours if you cannot eat a proper meal. If you either skip breakfast or refrain from eating for too long, the coating layer of bacteria on your tongue may thicken, and breath odor become more evident.



Third Strategy - Use Mouthwash Correctly

> Despite what most of us think, mouthwashes were invented long before the advent of Listerine®. Mouthwashes are mentioned in ancient Chinese and Hebrew writings. Here is a concoction from the seventeenth century:
>
> *"Take two handfuls of Rosemary Flowers and Leaves, and boyl them in as much White-wine as will something more than cover them, put into it a little Cinnamon, and Benjamin, beaten to powder, every Morning wash your Mouth with this, noon and night, and it will cure them."*
>
> Page 175 of the Compleat Servant-maid (London Bridge, Thomas Passenger, Printer, 1685, as reported by Dr. Max Geshwind, in the Bulletin of the History of Dentistry, 35:127-128, 1987).

Mouthwashes can be very helpful if the ingredients are effective and the rinse is used properly. The best time to use a mouthrinse is at bedtime. People often use rinses during the daytime, before meetings, social engagements, etc. During the daytime, the active agents affect the superficial, exposed bacteria in the mouth, but are quickly washed away by saliva, food and drink. They don't hang around long enough to penetrate the biofilms and optimize their potential. Thus, the best solution is to use the solution right before bedtime.



Secondly, it's important to gargle. Many people just rinse the mouthwash around the front of their mouth. That helps reduce the odor produced by bacteria in

and around the teeth, but is not helpful for the majority of bad breath-causing bacteria, which hang out on the very back of the tongue. That is why, in addition to rinsing, you need to *gargle*.

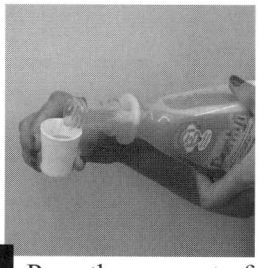
> Commercial mouthwashes usually contain a concoction consisting of flavors (mint, cinnamon, clove, etc.) that are often dissolved in the alcohol present in most mouthwashes. Mouthwashes may, in addition, contain various antibacterial agents such as cetylpyridinium chloride, triclosan, chlorhexidine, zinc salts, or oxidizing agents. Some commercial mouthwashes are quite acidic on the pH scale. If you have heartburn, acid reflux or acid indigestion, it is important to use a mouthwash with a more neutral pH to avoid irritation.

Gargling also takes some practice. In order to allow the mouthwash to reach the very back of the tongue, keep your tongue extended and tilt your head back a little. Breathe in through the nose and while you are gargling, make an "aaaah" sound. This will allow the mouthwash to penetrate all the way back towards the throat. Mouthwash should not be recommended for young children, as they might swallow it. Observe the directions on the mouthwash bottle. If it says to use for 60 seconds for best effect, then do your best to use it for the full recommended time. Finally, don't put too much mouthwash in your mouth at one time, so that you can really rinse and gargle vigorously. That's hard to do when your mouth is full.

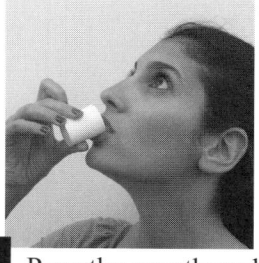
Probably, the strongest available commercial mouthrinses for oral malodor contain 0.2% chlorhexidine gluconate. They have not been freely available in the US where the permitted concentration has long been 0.12%. The lower concentration is bound to be less effective. Chlorhexidine is an antibacterial agent that sticks to oral tissues and hangs around the mouth for quite a while - this may explain its relatively high efficacy. Unfortunately, it has several side effects, including temporarily affecting taste, reversible discoloration of teeth, and ulcer formation in some people, and is not

How to Use Mouthwash

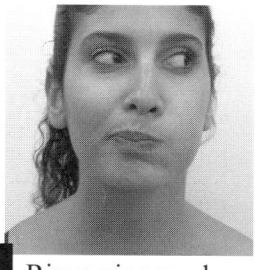
1 Shake the bottle well, if required.



2 Pour the amount of mouthwash advised by the manufacturer (usually half a cap).

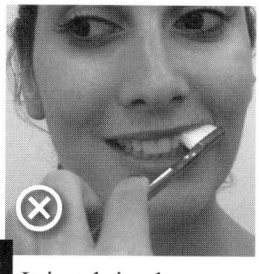


3 Pour the mouthwash into your mouth (without swallowing, of course).



4 Rinse vigorously, making sure the mouthwash cleans your teeth thoroughly.

5 Gargle, tilting your head backwards while extending your tongue, allowing the mouthrinse to clean the inner part of your tongue. Breathing through the nose sometimes helps while you gargle.



6 It is advised not to use mouthwash directly after brushing your teeth, as the detergent in the toothpaste can interact with some of the active ingredients present in many rinse formulations.

courtesy of Dr. Alon Amit, DMD

recommended for extended use. In Canada, it was considered for years to be an 'emergency drug'. Some dentists recommend chlorhexidine, in mouthwash or gel form, as an initial way to attack the bacteria on your tongue or between teeth and gums. If you rinse and gargle properly for a week with chlorhexidine mouthrinse and your bad breath goes away, that's a good indication that the odor is coming from somewhere in your mouth. Chlorhexidine mouthwashes are available over-the-counter in some countries, but it is best that you consult with your dentist before using them.

Sometimes, as previously mentioned (page 25), a significant amount of alcohol is added to the mouthwash. The alcohol is used as a carrier for the flavor, to provide 'bite' (the strong feeling of alcohol burning our cells makes people think it does so to the bacteria as well), and to contribute to the antimicrobial effect. Some types of mouthwashes contain over 20% alcohol. Alcohol-containing mouthrinses are not recommended for children, for rehabilitated alcoholics or before driving (you might fail a breathalyzer test after rinsing). Ask your dentist to recommend a mouthwash for you to use. If the dentist has a business selling a particular brand of mouthwash, take that into consideration. I am partial towards the alcohol-free mouthwash (Dentyl pH), which is a bestseller in the UK, but please keep in mind that I also invented it!

In 1994 a well-known dentist from London, Dr. Phil Stemmer, flew to see me in Tel Aviv. He was interested in setting up a clinic for diagnosing and treating bad breath, similar to the one I had in Tel Aviv. He fell in love with our two-phase mouthwash technology and proceeded to license it in the UK. The ensuing product, Dentyl pH, went on to become one of two leading mouthwash brands in the UK. The UK company was recently sold to an international corporation and, hopefully soon after this book appears, will be available throughout North America as well. Read more in my personal account, on page 142!

Internet recipes

I suggest that you stay away from internet 'recipes' and 'cures'. There are lots of chemicals out there that kill bacteria (some of them are even from natural sources). For example, we could prevent bad breath if we rinsed and gargled with acidic lemon juice or apple vinegar every day. The acid would inhibit and kill a lot of oral bacteria, and keep the pH low. Since bacterial odor production is inhibited in the presence of acid, this would further reduce bad breath. The only problem is that you would quickly lose the enamel on your teeth (which the acid dissolves).

There are also strong oxidizing agents (for example bleach) that can kill bacteria on contact. We use these materials to clean and disinfect toilets. But they are dangerous and harmful in the mouth, and not at all recommended. In my opinion, even hydrogen peroxide, another oxidizing agent, which we use to disinfect skin and wounds, is too harsh to use regularly in the mouth. Remember that the soft tissues in our mouth can be much more sensitive than our outer skin. So we have to be careful. Some internet concoctions do reduce bad breath, but may cause much more harm than good. On the other hand, when you buy a product in a reputable pharmacy or supermarket following your dentist's recommendation, you have three professional bodies to back you up: the manufacturer, the retailer and your dentist.

Separate the use of toothpaste and mouthwash

Most toothpastes contain high levels of anionic detergent (sodium lauryl sulfate), which can inactivate CPC, chlorhexidine and other active cationic antibacterial agents in mouthwashes.

So my recommendation is not to use toothpaste and mouthwash at the same time. For example, if you rinse with mouthwash before bedtime, you should brush your teeth with toothpaste at least one hour earlier. If you feel a need to brush again at bedtime, you can dip the brush in a cap half full of mouthwash and brush with the mouthwash, then rinse. If you do brush with mouthwash, try gently brushing your tongue as well, as far back as you can.

In the morning, if you want to use mouthwash, then I suggest the following. Brush your teeth with toothpaste, eat a wholesome breakfast, and then, before setting off for work, brush away the food debris without using toothpaste, then rinse and gargle with mouthwash.

Treatment Concept Two: Take Care of Your Teeth and Gums

Teeth and gums are the second important reason for bad breath. A colleague of mine, Dr. Sheldon D. Sydney, once wrote a book entitled "Ignore your teeth and they'll go away." Funny, but true.

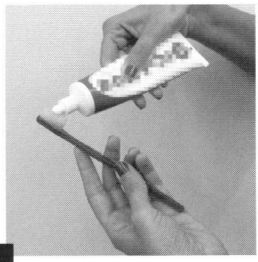
Strategy Four: Take Care of Your Teeth

You should brush your teeth properly (for a few minutes, not a few seconds) twice a day, according to the instructions of your hygienist or dentist. Don't forget to brush around the ends of each row of teeth. The most important area to concentrate on is the borderline between teeth and gums, as that is where bacterial plaque accumulates. Use a high quality brush with soft bristles. Many dentists recommend electric toothbrushes.

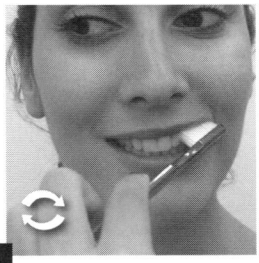
Replace your toothbrush frequently. Once a month if you can afford it. Once every two or three months if you can't. If the bristles are frayed, then either the brush is very old, or you are brushing too hard (don't). Please keep in mind that bacteria can accumulate on your brush as well, so do change it often. It is best to use just a pea-size amount of toothpaste. Using too much paste builds lots of foam which gives one the false impression that the cleansing is completed before it really is. Too much paste can also cause a burning sensation due to the essential oils. After you brush, take a little water into your mouth and try gargling with the toothpaste residue. As stated earlier, don't use mouthwash right after toothpaste.

As I mentioned on page 63, young children can develop bad breath because of accumulation of dental plaque. It's important to take care of your children's teeth. You can let young children practice brushing, but it's important to brush your child's teeth until they are able to proficiently brush by themselves. Use a tiny amount of toothpaste in the case of young children. Before you throw out their old toothbrush and buy them a new

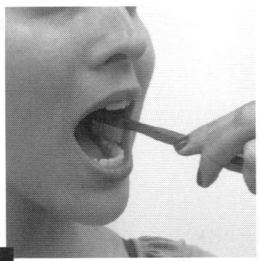
How to Brush Your Teeth



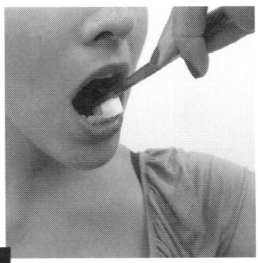
1 Apply a pea-size amount of toothpaste onto a soft-bristled toothbrush.



2 Align the toothbrush diagonally, focusing on your gum line, and gently brush your teeth in circular motions.

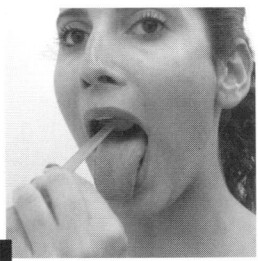


3 Make sure you clean each surface of each tooth, including the occlusal (chewing) surfaces of your molars.



4 Clean the inner surface of your teeth too – your incisors will require a vertical motion to be brushed properly.

5 Do not forget that brushing is not enough! You also need to floss regularly, as the toothbrush cannot get in between your teeth.



6 And of course – complete your oral hygiene routine with a gentle-but-thorough cleaning of your tongue.

courtesy of Dr. Alon Amit, DMD

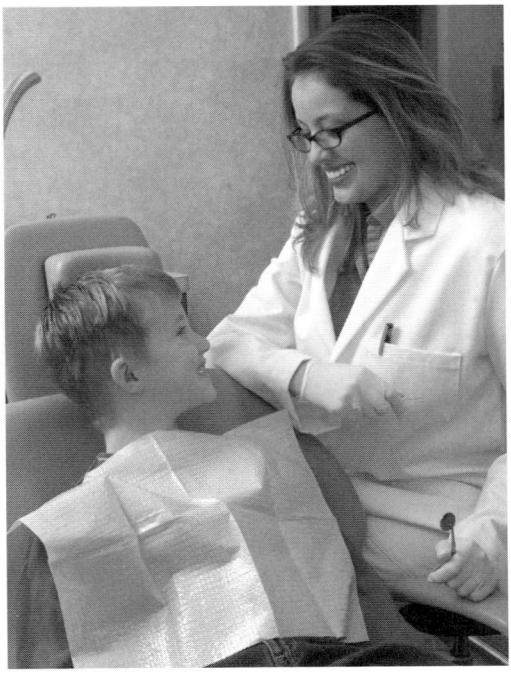
one, please have a look at my story "What to do with a Used Toothbrush" which is available for free on www.meltells.com. There are a few more stories available for free on that site, which can motivate children to brush their teeth.

Visit your hygienist on a regular basis to have your teeth cleaned. The standard recommendation is every six months, but this can vary from one individual to another. Find a hygienist who takes the time to teach you how to brush and floss properly. Good dentists and hygienists have patience with their patients.

Take good care of your teeth. If you lose them and have to wear dentures, chances are you'll regret not having taken better care of them. Dental implants provide a better solution than removable dentures, but they aren't cheap, require constant maintenance, and feel foreign.

If you suspect that there is odor coming from a leaky crown or problematic bridge, speak to your dentist frankly about it. Sometimes it's worth getting a second opinion. As mentioned, dental caries (cavities) don't usually cause bad breath, unless they are massive and food is getting trapped. Food can also get trapped and rot between teeth. Sometimes dental intervention is required to correct that problem. Finally, abscesses in the mouth can cause odor. Examples are bad cases of gum disease and infections around problematic wisdom teeth.

Strategy Five: Take Care of your Gums



Brushing your teeth is very important but, sadly, does not clean *between* your teeth. That's because the bristles in toothbrushes usually cannot penetrate the interdental space where a lot of bacteria and debris hide.

The bacteria that thrive between your teeth not only produce vile and harmful odors, but can eventually rot your gums if you don't clean there on a daily basis. As explained on page 51, when the gums rot, the tissue holding your teeth in place begins to fall apart as well. With time, your teeth wobble in their sockets and may fall out or have to be extracted. You might have perfectly white and lovely teeth, but if your gums go, your teeth will follow.

That is why flossing is so important. It is probably the most underrated dental activity. Only a few percent of people use floss (and many of them use it improperly). We did a study years ago showing that flossers have less bad breath. So if you want to have pristine breath, it's important to floss. I recommend unscented floss (either waxed or unwaxed, you choose what's convenient).

Here are several flossing tips:

- Don't just whip the floss in and out. That's not the proper way to use it (and it can damage your gums if you pull through too hard). Remember that floss is for removing the interdental plaque. The proper way to use floss is to gently insert it between your teeth in gentle sawing motions, and then using a sideways V type motion, wrap it around one tooth, move it up and down, and then in the opposite direction, up and down the other tooth. This technique cleans best. When you take the floss out, take a whiff. If there are areas between certain teeth that smell worse, it's an indication that they need more thorough cleaning. For more flossing tips, please visit the American Dental Hygienists Association website at http://www.adha.org/oralhealth/flossing.htm, or just read the next page!

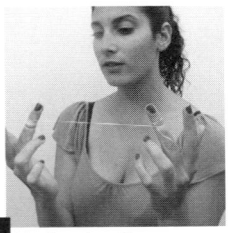
- Because the mouth is so full of bacteria, there will always be at least a slight smell associated with floss (this goes for saliva, plaque, and the tongue too). This does not necessarily mean that you have bad breath (remember, you have to ask your confidant).

- Don't forget to floss around the back teeth at the end of each row. That's because even though you clean there with your toothbrush, it doesn't manage to do a good job at the gumline.

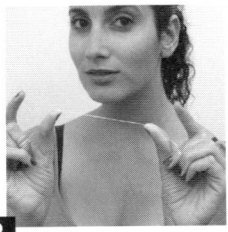
- Last, but not least, always have a routine, so that you remember to go all the way around, cleaning between and around *all* your teeth.

How to Floss

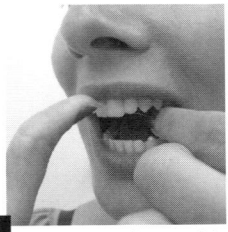
1 Use a long segment of dental floss.



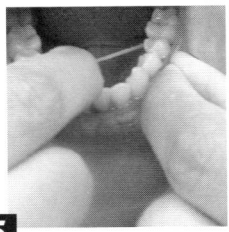
2 Twist the floss around your middle fingers, most of it on your strong hand…



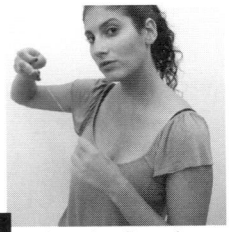
3 …so that you'll be able to control it with your thumbs and index fingers.



4 Insert the floss with a gentle sawing motion into each interdental space.



5 Pull the floss one way (in a V shape) and move it up and down. Then pull the floss the other way and move it up and down.



6 After the floss has accumulated some plaque, twist it around the other middle finger, and continue cleaning the next interdental space with fresh floss. Don't forget to wrap the floss around the last teeth in each row and clean there as well!

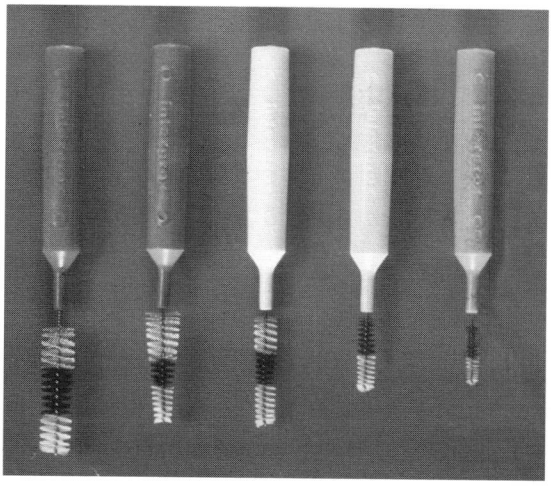
7 For best results, ask your hygienist and dentist to teach you how to floss best.

courtesy of Dr. Alon Amit, DMD

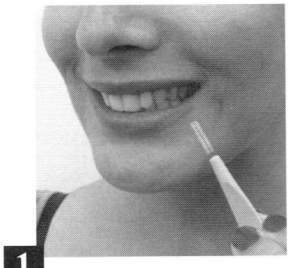
Strategy Six: Interdental Brushes

Many years ago, interdental brushes were large, cumbersome tools, and rarely recommended. Nowadays, there are also little disposable, one-piece interdental brushes that are easy to use and convenient to keep in your purse or pocket. Some tips on using these great gadgets:

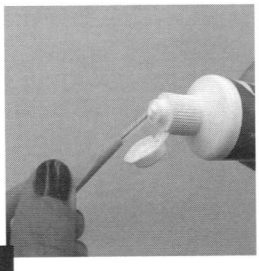
- Choose the proper sizes that fit comfortably between your teeth, but still rub the teeth as they pass through. You may need a couple of different sizes for different interdental spaces. Don't force them in.
- Try dipping them in toothpaste or mouthwash before you use them, for that added antibacterial and mechanical cleansing.
- They can bend, which is convenient.
- Replace them frequently. They're not cheap, but your teeth are much more valuable.
- They are not intended to replace floss, but they can really help clean between your teeth, especially during the day, when flossing is not feasible.
- Keep them away from young children.



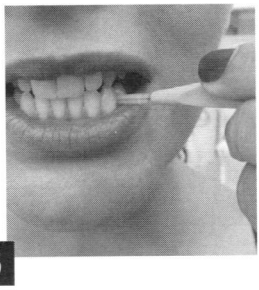
How to Use an Interdental Brush



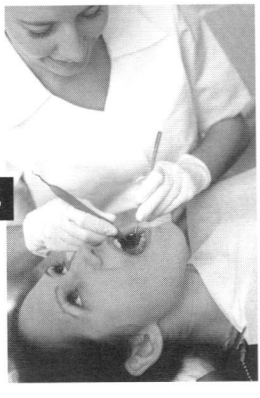
Interdental brushes (or "proximal brushes") are another way of cleaning between your teeth, and are advised for use in larger gaps. Choose a kind that fits in between your teeth. They do not replace flossing, though.



Apply a little toothpaste to the interdental brush



Gently insert the inter dental brush in between your teeth, while being careful not to harm your gums. Make sure you clean between all your teeth.



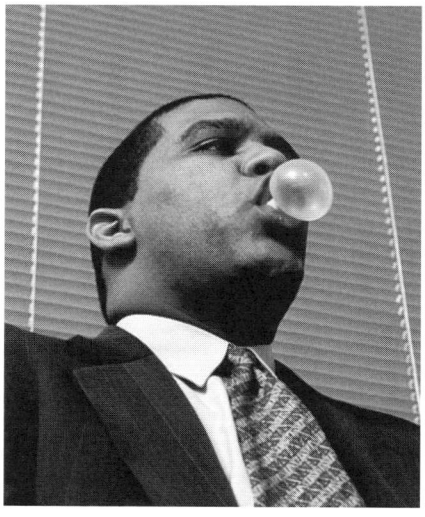
Consult your dentist and dental hygienist for other accessories you might need!

courtesy of Dr. Alon Amit, DMD

Treatment Concept Three: Avoid Dry Mouth

As I explained earlier, our mouths smell worse when they dry out. So it's in our best interest to avoid this unpleasant scenario. Several strategies:

1. **Eat healthy snacks** during the day. These might include fresh fruit and vegetables or dried fruit and nuts. Chewing anything gets the saliva flowing and mechanical cleansing underway.

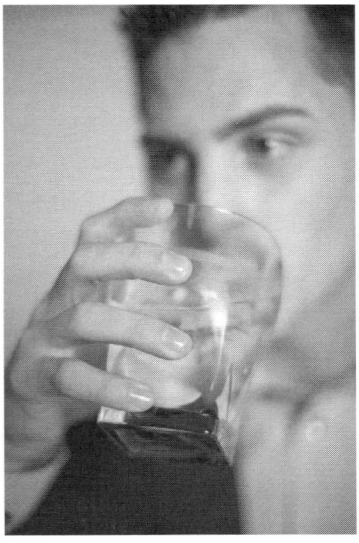


2. **Chewing sugarless gum** can really help reduce mouth odor. We have found that just a few minutes of chewing gum can reduce odor for two hours. If the chewing gum contains special anti-odor ingredients, it may even work better or longer.

Prolonged chewing of gum is not advisable. It can cause problems in the jaw (temperomandibular) joints of susceptible people. Secondly, some physicians feel that chewing sends false signals to the stomach that food is on its way, causing premature release of stomach acids.

Can't brush your teeth and gargle after lunch because you're at work? Go to the washroom for three minutes and chew some sugarless gum – the mastication and added saliva will help clear the mouth of food residues and bacteria. If you want to be really religious about it, bring along an interdental brush to clean between your teeth. Works great!

My advice, then, is to chew gum just for 4-5 minutes at a time, either when the mouth is dry, or after a meal, if you can't brush.



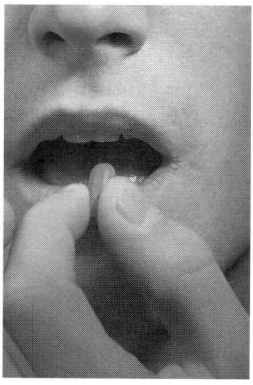
Drink enough rehydrating liquids. Having enough water in your body is very important, especially in warmer climates. Make sure to drink enough water and go easy on coffee.

Treatment Concept Four: Avoid Problematic Foods and Medications

In addition to alcohol and coffee, problematic foods to keep an eye on include milk and soy products (lots of proteins which oral bacteria love), garlic and onions, spicy foods, meat and fish. Such foods can either be degraded by the bacteria in the mouth to produce foul gases, or give off their own unpleasant odors. Again, if you can't clean your mouth after enjoying the above, chew sugarless gum for a few minutes.

Avoid being overweight. In a recent study carried out on 88 volunteers, we found that being overweight carries an extra risk of having bad breath. We don't know why yet, but in any case it's healthier to maintain proper weight. Exercise is also great, although it dries your mouth out (so chew gum for a few minutes afterwards, and drink plenty of water).

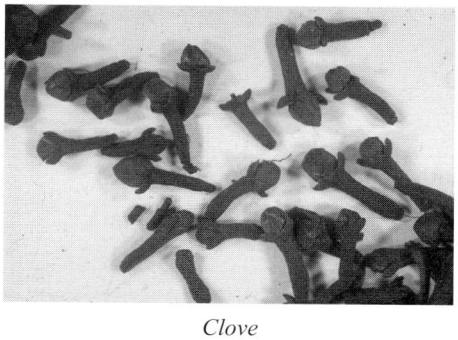
Avoid Antibiotics



Some dentists and physicians advise patients to take antibiotics to control bad breath. I think that this is ill-advised. First of all, it is true that the odor goes away when you are on antibiotics (because the bacteria causing the odors are being decimated). But the bacteria and their odorous products bounce back within a month or so. So what's the point? Antibiotics also kill the benevolent body bacteria that we need that provide us with vitamins and protect us from yeast overgrowth.

Natural Cures

Several ancient cures were described on page 78. What is interesting is that some of these do have a scientific basis. Many essential oils and plant extracts, such as gum mastic and the oil extracts of clove and cinnamon, have been shown by scientists to have antibacterial properties. Add to this the cleansing action of mastication (chewing) and you have a winning combo. So, yes, by all means, you can chew a little parsley after a meal. But don't be tempted to try those gelatin pills (containing essential oils) that you swallow. Bad breath doesn't come from the stomach and there is no evidence that they work.



Clove

Part Five: For Dental Professionals

Here is an updated version of the factfile that I originally wrote for the British Dental Association. It is aimed primarily at the professional community.

> In nine out of ten instances, bad breath (halitosis) comes from bacterial activity in the mouth. About 15-30% of the adult population suffers from bad breath on a regular basis. In most cases, bad breath can be greatly improved following proper diagnosis, dental care, oral hygiene and advice. Dental professionals can usually deal with this condition if it has an oral cause.

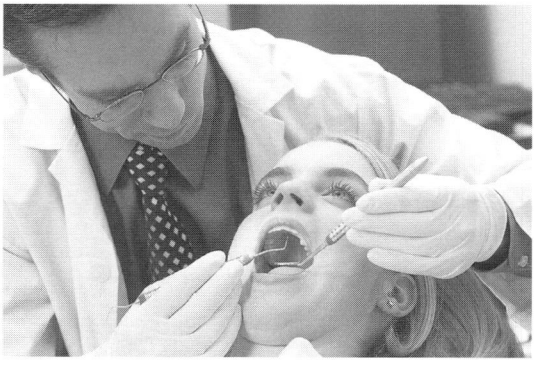
Diagnosing Bad Breath

In recent years it has become increasingly clear that bad breath is usually amenable to treatment once the causal factors are known.

Often, people who are worried about bad breath are poor at trying to assess how bad the problem is. Some worry needlessly. At the same time, many others (including some dental professionals!) may suffer from bad breath without being aware of it themselves. As a result, millions of people with bad breath go untreated, while others build up exaggerated fears about breath odor, even though they might have very little or none at all. The best way to judge whether one has bad breath is to seek the objective input of a third party, or "confidant" – a close adult friend or family member.

Since bad breath often comes from bacterial breakdown of proteinaceous debris within the mouth itself, it is a condition that dentists and hygienists can help alleviate. For this reason, and because bad breath can be a sign of disease in the mouth (or – fortunately, rarely – of a systemic illness), it is sometimes appropriate to broach the issue of breath odor with a patient.

Sometimes, patients will themselves raise the matter with their dentist or hygienist. If a patient has explained in advance that they will be asking for help with bad breath, they should be strongly encouraged to bring a confidant who is familiar with the situation. This can help to give an objective picture of how bad the odor really is, how long it has been going on, and when it improves or gets worse. Since bad breath often varies, the accompanying person can also help determine whether the odor at the time of the appointment resembles, in character and intensity, the odor that is generally present.



It is advisable to ask the patient not to eat, drink, smoke, chew gum, suck sweets, use mouthwashes, breath fresheners, etc., for at least two hours before the consultation, so that the odor will be more typical. It is also worth asking the patient to avoid using perfumed cosmetic products, such as fragrances, aftershave, and scented lipstick prior to the appointment, since these can interfere with the odor assessment. If the patient has been on systemic antibiotics within a month prior to the appointment, it should be postponed appropriately (since antibiotics may temporarily eliminate oral malodor for several weeks).

The dentist can determine whether there is oral malodor by comparing the odor coming out of the mouth (for example, while the patient counts out loud to twenty) with the odor coming from the patient's nose. If the odor is primarily from the mouth itself, then the origin is likely the mouth and/or throat. The odor from the back of the tongue can be sampled by gently scraping some of the debris from the posterior tongue dorsum using a plastic spoon while holding the tip of the tongue with some gauze.

If the odor is mainly from the nose, then the nasal passages may be responsible, and an ear-nose-throat consultation may be warranted. If the odor comes equally from the mouth and nose (rare) then a systemic problem may be inferred. In any case of doubt (or if the problem does not resolve), the patient should be referred to an appropriate physician.

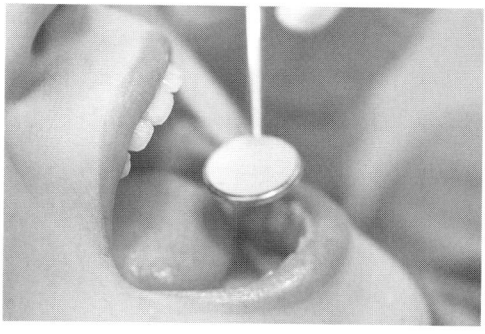
Another simple technique that may help diagnose whether the odor is of an oral origin is to prescribe a strong antibacterial mouthwash (e.g. 0.2% chlorhexidine in those countries in which it is allowed) for rinsing and gargling for one week. If the odor subsides, it is likely to be due to an oral aetiology.

The Causes of Bad Breath

Problem	Possible cause or source of malodor
Odor after fasting, dieting, sleeping, taking medications, stress, prolonged speaking or exercise	Dryness in the mouth, insufficient saliva flow
Gums bleed and/or smell	Gum disease, poor cleaning between teeth
Odor when talking	Postnasal drip on back of tongue, oral dryness
Small whitish stones with foul odor appear on tongue, possibly following coughing	Tonsilloliths from crypts in tonsils
Odor appears suddenly from mouth of young children	Onset of throat infection
Odor appears suddenly from nose or even entire body of young children	Foreign body placed in nose

Problem	Possible cause or source of malodor
Taste or smell of rotten fish, usually perceived mainly by the patient	Trimethylaminuria (rare)
Odor in denture wearers	Dentures not cleaned properly or not soaked overnight in antimicrobial solution
Odor from nose	Sinusitis, polyps, dryness, foreign body, blockage of airflow or mucus flow
Bad taste all day long	Poor oral hygiene, gum disease, excessive bacterial activity on tongue. Bad taste is not necessarily indicative, however, that there is observable odor.

Bad Breath Originating in the Teeth and Gums



The teeth and gums are a common source of oral malodor, particularly subgingival and proximal areas. Margins, overhangs, leaky crowns, and periodontal pockets are prime sites for anaerobic bacterial activity, which may lead to putrefaction and to odor. Patients with pronounced gingivitis may have particularly foul odor.

Patients should be advised about the importance of good oral hygiene in maintaining gum health and in keeping food traps clear (assuming that these do not require to be resolved by surgery).

A useful tip to pass on is to smell the odor coming from the dental floss following each passage between the teeth, and to work to clean more carefully those areas with the worst odor (it is best to use unscented floss for this purpose). The same applies to dental sticks or interdental brushes where these are used. It may be appropriate to suggest daily rinsing with one of several available mouthwashes that have been scientifically shown to reduce breath odors. In addition to rinsing the mouthwash between the teeth, it is highly advisable to gargle with the rinse as far back as possible, to inhibit the odor-causing bacteria on the back of the tongue. Mouthwash is probably most effective when used directly prior to bedtime. Mouthrinses that contain cationic active agents (such as cetylpyridinium chloride or chlorhexidine) may be inactivated by the anionic detergent in toothpaste, thus it is inadvisable to use mouthrinse directly after toothpaste.

Denture-wearers need to be advised about keeping dentures clean, as these can also generate bad breath. Since bad breath is worse when the mouth dries out (e.g. after talking a lot, during sleep, when under stress, or as the result of many medications), it can help to stimulate saliva flow by chewing sugar-free chewing gum for just a few minutes. It also helps to drink lots of liquid and not to drink too much coffee or alcohol, as these might worsen the situation.

Bad Breath Originating on the Tongue

The posterior dorsal tongue is the major site for oral malodor. In people with healthy teeth and gums, the odor usually comes from the far back region of the tongue, and grows stronger when the patient starts talking or the mouth is dry. The odor from the back of the tongue differs in character from the dental odors described above. This is an area of the tongue that is poorly cleansed by saliva, and is heavily populated by aerobic and anaerobic bacteria that can putrefy the proteins present in food debris, desquamating epithelial cells and postnasal drip. Some studies have shown a relationship between tongue coating and oral malodor. The tongue may

also serve as a reservoir for periodontal pathogens, which may contribute to the odor. If the back of the tongue is the problem, then cleaning the area with a specially designed plastic tongue scraper can be recommended (in some countries, tongue cleaning is a common and ancient practice). Several types of tongue cleaner are now available. It takes time and patience to overcome the gagging reflex but, eventually, tongue cleaning becomes easy. Care should be taken to clean the back of the tongue gently, so as not to inflict pain or sores or otherwise traumatize the tongue. A toothbrush, without toothpaste, can also be used to scrub the tongue gently.

Interestingly, eating rough foods reduces tongue coating, and thus eating a wholesome breakfast may often contribute to improvement.

Bad Breath Originating Outside the Mouth

The nose and nasal passages can also be the site of bad breath. Sinusitis and other bacterial infections, blockages of the airway, and dry nasal mucosa can all contribute to malodor. Furthermore, a blocked nose causes mouth breathing, which dries out the oral cavity and can result in bad breath. In children, foreign bodies in the nose can cause bad breath, sometimes resulting in an odor so foul that it completely envelopes the body.Tonsils may, on occasion, be responsible for oral odor. Tonsil stones (tonsilloliths), consisting of partially calcified debris and rich in anaerobic bacteria, may develop in tonsillar crypts, and be released into the oral cavity in about 5% of patients. Although the stones themselves smell, particularly when pressed, they do not necessarily contribute to oral malodor.

Hundreds of diseases (e.g. bronchial and lung infections, various carcinomas, metabolic dysfunctions, biochemical disorders) can result

in bad breath, but all these taken together account for all only a very small percentage of those suffering from the problem.There is a common misconception that bad breath comes from the stomach. However, with the exception of burping, bad breath from the stomach is extremely rare. Systemic treatment of *Helicobacter pylori* with antibiotics generally does result in a temporary improvement in oral malodor, probably due its concomitant inhibition of the oral microorganisms that are responsible for the odor.

Self-Perceived Bad Breath

Some 25% of patients complaining of pronounced oral malodor seem to have little or no bad breath at all. Such patients remain convinced that they have bad breath for various reasons. Sometimes they notice bad breath in others (e.g., parents) and assume that they must have a similar problem. In some cases they misinterpret the behavior of others (opening a window, rubbing one's nose, offering a mint) as a sign that they have bad breath. Bad taste is often misinterpreted as a sure sign of bad breath (it is not). The presence of tonsilloliths can also lead to exaggerated concern. Some were told once, many years ago, that their breath smelled, and continue to harbor this fear, without actually consulting anyone to see whether such a problem persists. In many cases, overconcerned patients may shun social situations and suffer impaired quality of life. They may be reluctant to bring an objective third party to the appointment, yet should be strongly encouraged to do so.

Patients with concerns of bad breath are often so sure that they have it, that they usually proffer disbelief when the professional tells them that there is no oral odor. These patients have a strong conviction that they have an actual medical condition, and are not likely to agree to seek psychological counseling (at least, not initially). However, together with feedback and reinforcement from a family member or close friend, they can, over time, gain a more objective perception of the situation.

Summary

Patients who complain of bad breath should be encouraged to bring along a close adult friend or family member to the appointment who can help the dentist determine whether the odor at the time of the appointment resembles the typical odor. This person can also notify the patient over time whether the odor has improved following the consultations.

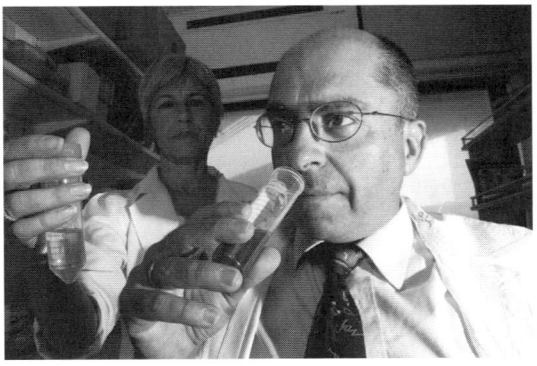
In the great majority of cases, bad breath can be eliminated or improved by:

- Proper dental care and treatment
- Oral hygiene, including daily flossing
- Eating a wholesome breakfast, and healthy snacks during the day
- Drinking sufficient water, and avoiding coffee and alcohol when possible
- Using a flat, plastic tongue cleaner to gently remove the debris from the posterior dorsum of the tongue
- Chewing sugarless gum (briefly) when the mouth is dry or after eating foods rich in protein
- Rinsing and gargling with an effective mouthwash at bedtime

Last but not least, dental professionals should consider making their patients aware of the connection between poor oral hygiene and oral malodor (particularly with regards to flossing).

This can help motivate patients towards improved professional dental care, and to more conscientious oral hygiene practices at home.

Part Six: My Personal Story



For over twenty years, I have been smelling other people's breath, as a researcher, inventor, and private consultant. I lost track long ago of how many thousands of people I have smelled, and haven't a clue whether or not I qualify for a Guinness world record. People often ask me how I ended up getting involved in this rather uncommon profession. The following is a personal account.

I have always loved to smell. One of my personal favorite odors is the 'Canadian autumn smell'. It's an odor I associate with football and with being young and carefree. Having moved from Ottawa to Israel at the age of seventeen, I had filed it away somewhere in the steppes of my brain. Twenty years later, on sabbatical in Toronto, I stepped out on the porch and there it was! A delightful flood of feelings that is hard to describe in words..

There is also the certain smell of tomato soup that brings me back to the school cafeteria that I frequented in Ottawa exactly fifty years ago. Another thing I have done for many years is smell babies (their necks and heads in particular). People meet me after dozens of years and ask, "Do you still smell babies?" Well, of course I do. Doesn't everyone? I was very close to a great aunt on my mother's side, Auntie Rochel. Come summer, Rochel would drench herself in Coppertone tanning lotion. Whenever I

think of her, I smell Coppertone. And although the smell is not intrinsically very appealing, when conjured up in this regard, it is for me.

Everyone with a sense of smell has, or should have, similar stories. Smells are known to be processed in a primitive part of our brain and have the uncanny ability to evoke distant memories and strong emotions. Thus, it is not surprising that, to a *certain extent*, we classify odors based on memories and experience. The smell of cow excrement may be vile to most of us, but for someone who grew up on a farm, it may conjure up fond recollections of the dissolved past.

Farts are smells that we all recognize at a distance, yet tend not to discuss in public. Everyone has at least one good fart story. I remember entering an elevator just as a man, grinning from nostril to nostril, exited. I strolled in, the door closed, and I was suddenly enveloped by the bacterial processing of his last few meals. Talk about leaving your mark! Of course, we tend to resent other people's flatulence, but are quite complacent about our own. Complacent? I actually don't mind many of my own farts. I used to think I was a little perverse in this matter, but last year I had a heart-to-fart talk with a fellow researcher whom I hold in particularly high esteem. He told me about experiments he conducted as a child, catching bathtub farts in jars, and then performing household analytical chemistry on them. I felt much better after that.

To some extent, farts are being increasingly outed these days. Witness a whole verse dedicated to the subject in the song "Hakuna Matata" in Walt Disney's "The Lion King." When I was a kid, the subject was so taboo that when I read that famous line on page 17 of Salinger's "Catcher in the Rye" ("This guy sitting in the row in front of me, Edgar Marsalla, laid this terrific fart"), it titillated almost as much as Playboy. In some societies, letting loose a fart in public is considered so humiliating that suicide may be contemplated and sometimes consummated (by the farter, usually). For the reader interested in probing deeper into the subject, several books on farts have recently published by some long-winded authors. Check out,

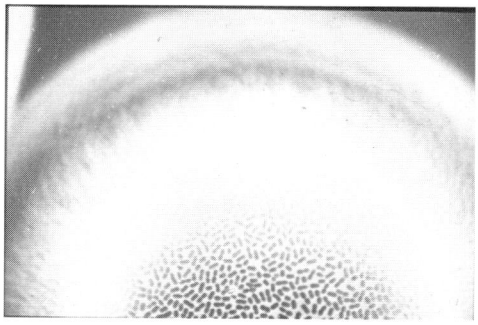
for example, "It's a Gas – A Study of Flatulence" by E.S. Rabkin and E.M. Silverman. Finally, the bestselling application of the iPhone is currently iFart. I rest my case.

But I digress. It seems to me that I got involved in bad breath by a string of coincidences. I don't remember anybody in the family having bad breath. I don't recall a teacher with oral malodor (although we had one who spat a great deal as he taught us Hebrew).

My fascination with oral research began one day in 1977. While on an army furlough, I visited the laboratory of Eugene Rosenberg at Tel-Aviv University. Eugene was by that time famous for his research (together with David Gutnick) on bacteria that "eat" oil. Eugene had taught a superb lab course in advanced microbiology, which I had taken as a graduate student, and I was a fan of his. I decided that if I ever did take up research towards a doctoral degree, it would be with Eugene. There was also that splendid fit of our family names (to this day people I meet at conferences are sure that we are related). So, every so often I would look in on Eugene in his lab. On that day in 1977, there were a few people in the lab, swishing and gargling with different solutions, trying to dislodge oral microorganisms. Eugene was doing a 'Swedish Cook' type experiment with Herbert Judes, a prominent prosthodontist, who was a mover and shaker in the fledgling Dental School at Tel Aviv University.

When I finished my army service, I was twenty-seven, and what I really wanted to do was to sell pianos. My wife, Shulamit, convinced me to go back for my Ph.D. "When you finish," she said, "you can always go back to selling pianos if you want to." So after many fits and turns, I began my thesis work under the aegis of Eugene Rosenberg and Dave Gutnick. I had wanted to work on oral research, and had set my mind on studying gum mastic, a biblical chewing gum (discussed on page 78). Eugene prevailed upon me to work on their ongoing project in oil (petroleum) microbiology, which he and Dave were very excited about. They were studying bacteria that are able to digest petroleum, with an eye to using microbes to clean up

the world's oil. At one point, Eugene told me, "When you've finished your research here, you will be able to apply it to studying oral bacteria." I am sure he was being facetious. But it turned out to be quite prescient.



Bacteria on a single oil droplet

The oil-eating bacteria in the laboratory were observed microscopically to be sticking to the oil droplets (giving them direct access to the insoluble oil). My role as a Ph.D. student was to figure out what made them stick. We thought that this would be a property unique to those bacteria that consumed petroleum, and not shared by other bacteria. However, it soon became apparent that some other microorganisms were also able to stick to oil droplets, including some bacteria that can cause disease. At about that time I met Ervin Weiss. Ervin was my wife's dentist. She was charmed by him, and insisted that he come over to visit us one evening. Ervin had already done some dental research and had plans to join the Dental School. He walked into our apartment with a suitable anesthetic (a bottle of whiskey), and we talked through the night on the hypothetical (at the time) dream of someday doing research together. The dream indeed came true, and within a year we were at work in Eugene's lab, trying to determine whether bacteria from the mouth also stuck to oil droplets. We happily discovered that bacteria, scraped directly from dental plaque, had a dramatic propensity for sticking to oil droplets.

One morning Ervin and I met in the hall with the same idea. If bacteria from the mouth stuck to oil droplets in test tubes, why not try a mouthwash with oil droplets, which could unstick and remove oral microbes? At the outset, we didn't really have too much faith in the idea but, having received a sizeable sum of research money for it, we got down to work. One of the experiments I remember was swishing with an unpalatable mixture of salt water and olive oil. One could see that piles of bacteria and other debris

came out of the mouth, attached to the oil droplets. We were ecstatic. We then proceeded to try to sell the idea. One of our first meetings (probably early in 1983) was at Teva pharmaceuticals, today a huge international concern. They expressed no interest in a mouthwash that worked by desorbing oral microorganisms. This was decidedly antiprophetic, as soon thereafter, a mouthrinse that purported to remove bound plaque bacteria (Plax) became the rage. But the folks from Teva did point out to us that the main reason people use mouthwash is to fend off bad breath. That sent me scurrying off to the library to read about bad breath.

I must confess that until that moment in my life, bad breath didn't concern me in the least. I couldn't have cared less. In my thirty-two years of breathing in and out on this planet, no one had ever told me I had bad breath and I never told anyone who did. Therefore, this journey to the library was a nose-opener. I learned that the research 'heavy' in the field was Joseph (Joe) Tonzetich of the University of British Columbia.

I was later to meet Dr. Tonzetich on several occasions, and will talk about that a little later. Joe had spent several decades showing the relationship between sulfur-containing molecules and bad breath. He was sure that these molecules, which have a smell akin to rotten eggs or natural gas, actually cause bad breath. His papers excited us. The molecules he was referring to were likely to stick to (or dissolve in) oil droplets, as well as the microbes that produced them.

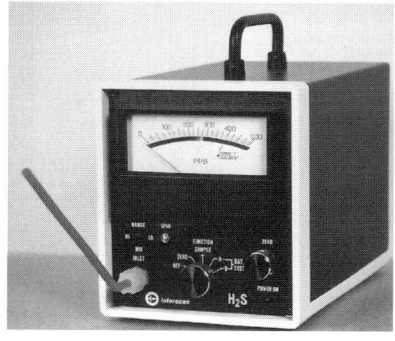
But in order to study the volatile sulfides that Joe was talking about, and to test our mouthwash concoctions, we needed some way to measure them in the laboratory. The method that Tonzetich pioneered was using gas chromatography (GC). The gas chromatograph is a complicated and expensive instrument, and requires trained and dedicated personnel. Gas chromatography involves trapping the gas on a solid support material embedded in a column and then releasing it (for example by stepwise increases in temperature). Each gas comes out at a different time at a given temperature, and can be detected on the way out of the column. We didn't

have one at our disposal. As I'll explain below, we had no choice but to improvise. Research projects often stem from chance meetings. In 1985 I bumped into Dr. Jacob Gabbay, a government expert on air pollution, on the campus at Tel-Aviv University. Jacob had long been a friend of my wife's family (even after buying their Sunbeam car!). I explained my growing interest in bad breath, and tried to get him interested in this type of human pollution. He already knew a lot about some of the gases involved, as they are common industrial pollutants as well. Jacob became interested, and we started our collaboration.

We both perceived the commercial potential in developing a small bad breath detector, a portable pocket or household gizmo that tells you when you have bad breath. Since then (twenty years ago), several have appeared on the market, but unfortunately they do not appear to work. After all, you don't want an instrument that only starts to beep when others have already passed out. They aren't specific either. They sometimes start to beep when your breath is fine.

The reason that no one has succeeded in a reliable, handheld 'breathometer' has to do with the extremely low concentrations of gases involved. Our nose is exquisitely sensitive to the presence of several of these molecules among a billion molecules of air. At present, no technology can nose out the nose when it comes to bad breath, although electronic noses can sniff out other compounds.

One day, Jacob came into my laboratory with "bad news and good news." The bad news was that he had, somewhat predictably, failed at making a portable bad breath sensor. The good news was that perhaps someone else had but did not know. That someone else was a company in Chatsworth, California named Interscan Corp. which manufactured



sensitive instruments for environmental monitoring of various types of gases. Model 1170 was specifically used for monitoring volatile sulfides in the workplace and open air. Jacob put the small black box on the lab bench. It had several knobs and a scale with a red needle. "I bet you this works for bad breath as well," he ventured.

We toyed around with the instrument for several days, mainly sampling air from our own mouths. One of the initial shockers was that our own breaths seemed to get the red needle moving. Either we had oral malodor (perish the thought) or the instrument was reacting to some other components in our breath. Eventually I told Jacob that his breath wasn't so good, and he reciprocated in kind. This was the first time that it occurred to either of us that we might have bad breath. And a machine tipped us off!

The next step was to test it scientifically. If you want to convince the world that you have an electronic instrument that helps measure bad breath, the critical step is show it experimentally. However, we had little to go on. Few scientific papers had been published comparing instrumental analysis of breath gases with actual odor levels. That isn't to say that breath research hadn't been going on for decades. However, unfortunately, most of it had gone on behind closed doors in private companies, and was not published for all to see. I have had serious disagreements with industry scientists on this point over the past two decades, and happily more of them are now publishing at least some of their research findings. Most of the published studies used a gas chromatograph, which we didn't have. What we ended up doing is what scientists do when they want to get on with an experiment but don't have the optimal setup. They improvise.

We 'designated' seven people as odor judges. Each odor judge eventually had to smell 76 people twice, so 'designated' meant coercion or bribery. The seven consisted of a dental student, Idit Septon, who took it on as part of her dental thesis requirements, Idit's fiancé (coercion), Idit's fiancé's brother (bribery), two of Jacob's technical staff (coercion), myself, and one delightful Ph.D. student, Ronit Bar-Ness, who actually volunteered.

Our gang of seven was not the usual experienced odor judge panel. Aside from Jacob's two technicians, we had little or no background in grading malodor of any kind. So we learned on the fly. We used the six point odor scale discussed on page 92.

In fancier laboratories, such experiments are often carried out using opaque dividers, with small holes cut in them. Sometimes hollow tubes are used. The person whose mouth is being smelled, the 'smellee', breathes into the hole or tube and the 'smeller' smells what comes out. Subject and judge do not see one another. In this manner, the judge cannot be influenced by the sex or appearance of the subject. Often the room's environment is also controlled and monitored (temperature and moisture). However, we did not have such a set-up, so we smelled the mouths directly, and trusted the objectivity of our judgment.

Following a radio interview, we recruited 76 volunteers and smelled them, one and all. The results showed a significant positive association (correlation) between the odor judge scores and the levels of volatile sulfide recorded by the instrument. In other words, we found that the higher odor judge scores tended to yield higher instrument readings. The chance that this association was a freak occurrence (like flipping a coin and getting heads thirteen times in a row) was less than one in ten thousand. Nevertheless, not all the high scores given by the jury correlated with high instrument scores, and vice versa. In other words, there were cases of bad breath that did not rock the instrument, and there were high instrument scores which did not correspond to fainting-type odor. These results troubled me to some extent, and I did not write up the manuscript summarizing this data for several years. One day I asked our statistician to see how well the various judges' scores corresponded with each other. Did all the judges agree with one another on how to evaluate Tom, Dick

and Harry? No way. In fact, in the majority of cases, each judge's scores corresponded better with the instrumental data than with one another. This then, made me feel somewhat more comfortable. What the data was telling us, then, was that the instrument was measuring something connected to bad breath. Nevertheless, the instrument could not be used on its own to tell patients whether or not they had bad breath. It could, however, serve as a backup - as an adjunct measurement. It could also be used to measure improvements following treatment. Its simplicity made it a decent tool for doing research studies. The results of the initial clinical experiment were published in 1991, in the "Journal of Periodontology," in a paper entitled, "Halitosis measurement by an industrial sulphide monitor."

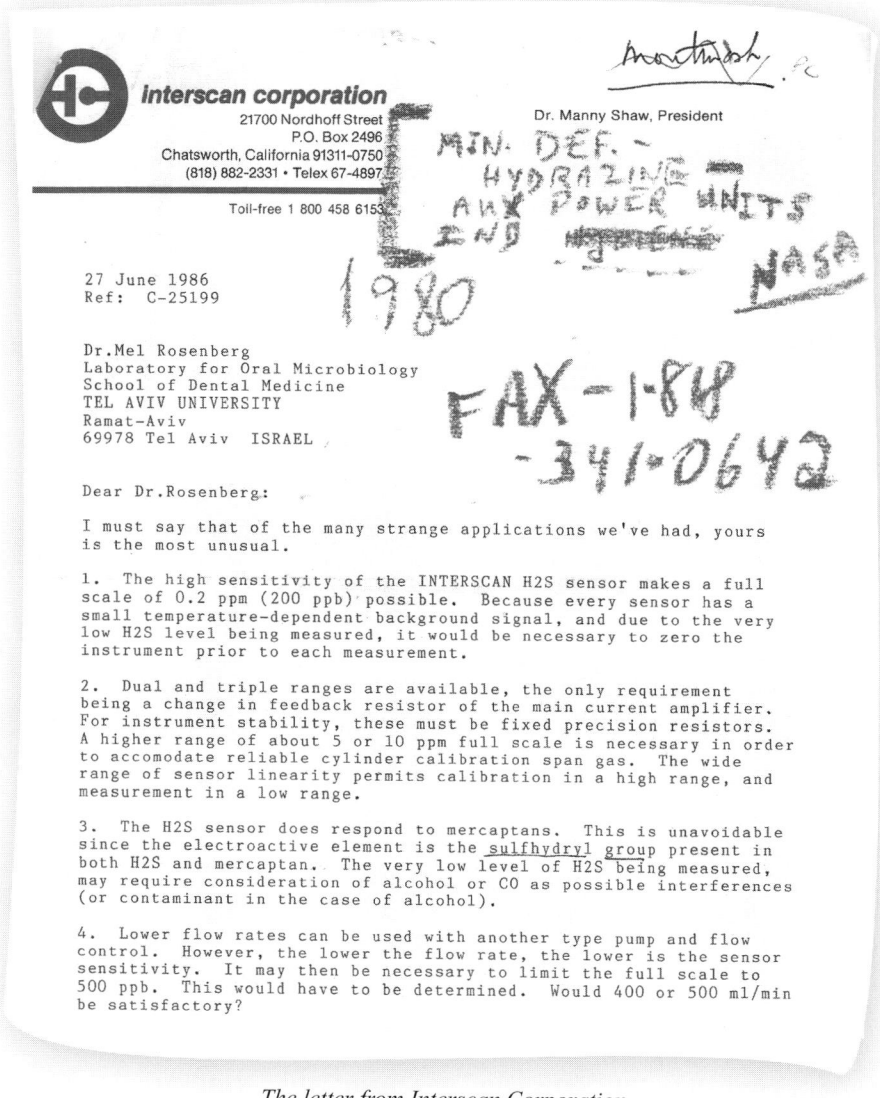
With the initial results of our experiment in hand, we wrote to the manufacturer to share the good news. Interscan Corp. was largely a one-man show. The president of the company, the scientist who developed the sensor at the heart of the instrument, was Dr. Manny Shaw. I was confident that this guy, whoever he was, would be so delighted with this novel application for his instrument, that he would provide tens of thousands of dollars to support our research. Instead, I got a long, initially negative letter which began:

"Dear Dr. Rosenberg:

I must say that of the many strange applications we've had, yours is the most unusual."

Obviously, this fellow was a tough cookie. He was not particularly impressed with our findings. Nevertheless, his letter ended on a somewhat positive note implying that some form of cooperation (definitely not money) might be possible.

That summer I visited the venerable world famous researcher of saliva at Stony Brook on Long Island, Israel (often nicknamed "the Chief" or simply "Is") Kleinberg, and told him about our early research. Is suggested that we give Dr. Shaw a call. This was not difficult, as we had his 1-800



interscan corporation
21700 Nordhoff Street
P.O. Box 2496
Chatsworth, California 91311-0750
(818) 882-2331 • Telex 67-4897
Toll-free 1 800 458 6153

Dr. Manny Shaw, President

MIN. DEF. - HYDRAZINE AWX POWER UNITS END

NASA

1980

27 June 1986
Ref: C-25199

Dr.Mel Rosenberg
Laboratory for Oral Microbiology
School of Dental Medicine
TEL AVIV UNIVERSITY
Ramat-Aviv
69978 Tel Aviv ISRAEL

FAX-1-800-341-0642

Dear Dr.Rosenberg:

I must say that of the many strange applications we've had, yours is the most unusual.

1. The high sensitivity of the INTERSCAN H2S sensor makes a full scale of 0.2 ppm (200 ppb) possible. Because every sensor has a small temperature-dependent background signal, and due to the very low H2S level being measured, it would be necessary to zero the instrument prior to each measurement.

2. Dual and triple ranges are available, the only requirement being a change in feedback resistor of the main current amplifier. For instrument stability, these must be fixed precision resistors. A higher range of about 5 or 10 ppm full scale is necessary in order to accomodate reliable cylinder calibration span gas. The wide range of sensor linearity permits calibration in a high range, and measurement in a low range.

3. The H2S sensor does respond to mercaptans. This is unavoidable since the electroactive element is the sulfhydryl group present in both H2S and mercaptan. The very low level of H2S being measured, may require consideration of alcohol or CO as possible interferences (or contaminant in the case of alcohol).

4. Lower flow rates can be used with another type pump and flow control. However, the lower the flow rate, the lower is the sensor sensitivity. It may then be necessary to limit the full scale to 500 ppb. This would have to be determined. Would 400 or 500 ml/min be satisfactory?

The letter from Interscan Corporation

number. Everyone answers their 1-800 line. So did Manny. We had a long talk with him. He wasn't particularly forthcoming, until the part of the conversation that went something like this:

Manny to Mel: Say, you speak pretty good English for an Israeli. Where did you pick it up?

Mel to Manny: Well, I'm from Canada originally.

Manny: No kidding, so am I! Where were you born?

Mel: Winnipeg.

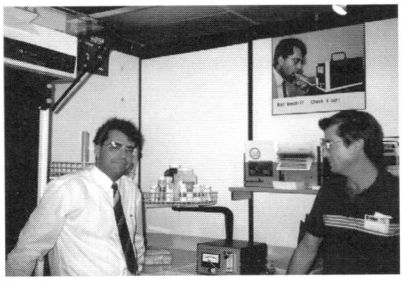
Manny: No kidding, I grew up in Winnipeg. Who are your parents?

Mel: Harry Rosenberg and Faigel Gorelick.

Manny: Hold on a sec. (in the background: Hey Molly, did you know a Harry Rosenberg from Winnipeg? How about Faigel Gorelick?)

To make a very long phone call short, my mother had grown up in an apartment building supervised by Molly's father, and my Dad had grown up down the same street as Manny. The following year, I was able to arrange a rendezvous after 40 years, and we all spent a lovely evening at the Tel Aviv Hilton, reminiscing about Winnipeg during the Great Depression.

Manny was indeed a tough fellow, but the Winnipeg connection softened him just enough to cooperate. Later, when he cottoned on to the commercial potential, he sent us parts from the factory, and we put together the first prototype (Halimeter RSH-1), a 'dental' model with lights that went on and off, depending on how high the score was. We toyed with the idea of having a siren go off if your malodor exceeded a certain value, but relented. Manny proceeded to manufacture the "Halimeter®" at Interscan. It eventually became the main product of their entire company, and they are still selling thousands of them around the world (after almost twenty years!). Some are used by scientists to further bad breath research, others in dental clinics. The relative low cost of the Halimeter (usually about $2,000) and its ease of use enabled researchers around the world to study bad breath-related issues.



Exhibiting the very first Halimeter - model RSH-1

Sabbatical at the University of Toronto

In July, 1989, I embarked together with my wife and five year-old daughter for a sabbatical at the University of Toronto. This year was so critical for me because I had never actually done a post-doctoral fellowship, which is expected of most researchers, and thus really needed the exposure to a large North American University. It was also important for me to make up my mind as to whether I had made a good choice in deciding to leave Canada just before I was 18, for a life spent mostly in Israel.

My host on sabbatical was Richard P. Ellen, an internationally known and respected periodontist who had chosen to devote his entire career to research (on how bacteria and human tissues interact in the oral cavity). At that time Richard was Chair of the Periodontics department, and showed a keen interest in our fledgling work on oral malodor. Although this was not the official topic of my sabbatical, Richard was generous enough to allow me to link up with C.A.G. (Chris) McCulloch. Chris, in turn, agreed to help me out in conducting a clinical study.

The turning point came on November 25th, 1989, when Dr. Malcolm Yasny wrote an article about fledgling bad breath research in the Saturday "Toronto Star." Following the article, I received over two hundred letters from all over Canada and the US as well. They told poignant, personal stories of suffering, sometimes for over 50 years. These letters convinced me, more than anything, that I had to make breath diagnosis and treatment the main topic of my career.

Following the article in the "Toronto Star," I appeared on national television. All this public interest helped persuade the faculty in Toronto to support a clinical study in which we would interview, test, and treat patients complaining of bad breath. We were able to purchase a sulfide monitor from Interscan, and hire a hygienist (Anne Bosy, who went on to do her M.Sc. with Chris) to help conduct the research. This study, which included 41 subjects and which was published in the "Journal of Dental Research"

in 1991, confirmed that the sulfide monitor could provide reproducible data alongside odor judge scores, and was sensitive to improvements following one week of gargling with a potent chlorhexidine mouthrinse. Interestingly, many of the patients did not appreciate that their breath had improved following this regimen.

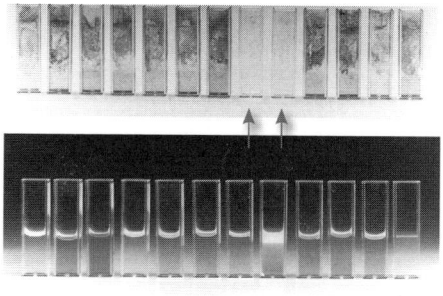
During my sabbatical I drove down to the University of Rochester to give a lecture on our initial findings. Bill (William) Bowen, who was then President of the International Association of Dental Research, suggested that I organize a symposium on bad breath at the upcoming international dental research meeting in Acapulco the following year. Nearly 100 scientists attended, with Joe Tonzetich giving the main presentation. This was followed by a conference in Herzliya, Israel in 1993. At the Herzliya meeting, Daniel van Steenberghe (Leuven, Belgium) suggested that we form a research society, which we named "ISBOR" (the International Society for Breath Odor Research). ISBOR is still going strong, and last month we held our 8th international meeting in Dortmund, Germany.

ISBOR board at Dortmund, April, 2009

Back to the Two-Phase Mouthwash

Back to our fledgling oil:water mouthwash research. In the mid 1980s we had two major breakthroughs. During a presentation to a local pharmaceutical company, Dr. Yoel Konis asked me why we had not considered adding CPC to our formulation. CPC (cetylpyridinium chloride), is, after all, a common anti-bacterial agent used in several leading mouthwashes. I explained to him that it was a silly idea. CPC also sticks to oil droplets, and would prevent the bacteria and debris from doing so, I explained. But just to show him how ridiculous his idea was, I asked my M.Sc. student, Sarit Goldberg, to add different concentrations of CPC to the oil and water mixture. At high CPC concentrations I was right, but there was a window of concentrations where the CPC actually *helped* the bacteria stick to the oil droplets. How could this be? As it subsequently turned out, some of the CPC was sticking to the bacteria, helping them to adhere better to the oil droplets. Lucky for us, the concentration of CPC that worked was close to the optimal concentrations used in other washes. Adding it improved several critical properties of the mouthwash.

The second breakthrough happened by accident. To impress a potential investor, we added a blue food color to the water phase to make the formulation appear more commercial. But after gargling with it, a funny thing happened. The blue color in the water disappeared. We found the color on the oil droplets, where it had stained the adhering bacteria and debris. Without knowing it, we had chosen a food color that is also a biological stain! Thus, after rinsing with it, one can see the bits of bacteria and debris



Removing bacteria from plastic cuvettes with varions rinses. The arrows show the removed film following mixing with our oil-water combinations.

sticking to the oil droplets. It serendipitously became the mouthwash that "you can see working."

Despite our advances, dozens of major and midsize companies turned down the two-phase mouthwash, for a variety of reasons. Some of them thought that consumers would not be willing to shake a two-phase mouthwash before use. Turning a laboratory invention into a commercial product was proving to be more daunting than I expected.

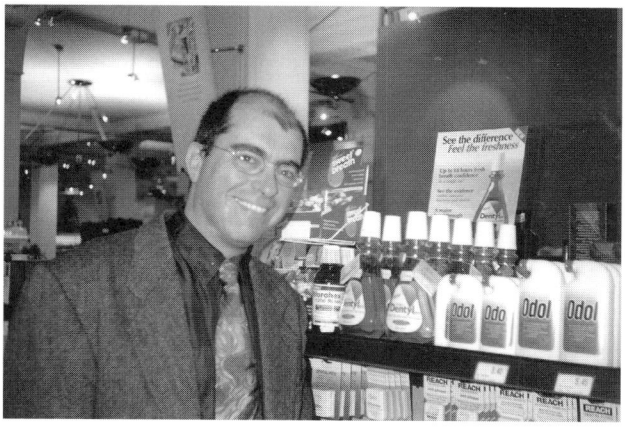
That year, in frustration, I petitioned Tel Aviv University to let me manufacture samples of the mouthwash by myself (this would have been a disaster, as I still have no manufacturing expertise). At the last moment, fate took the form of a telephone call. Chaim Regev, head of marketing at Israel's largest manufacturer of toothpastes and other household products (Shemen-Soad Ltd.), had heard about the mouthwash from a newspaper article. He told me that they had been distributing an ordinary mouthwash which was selling very poorly, and were interested in a new product. They had thousands of empty bottles lying around, and needed a formula to fill them. I explained the advantages of the two-phase product, and mentioned the issue of having to shake it before use. Chaim Regev turned the disadvantage into an advantage. "We'll emphasize the need for shaking. We'll color each phase in bold hues. People with bad breath won't mind shaking a container if they believe the results will be positive."

The first two-phase mouthwash, named "Assuta™" (Aramaic for "health") was launched in November, 1992. It had the problem, common to new products, of getting shelf space in the retail outlets. We spent a whole day trying to persuade the leading chain of local drug marts to carry it, and ended up selling only 72 bottles to over 20 stores! However, a week later I appeared on a popular local talk show. The host of the

show and I both gargled in front of the cameras, and I showed the audience how the new mouthrinse works. Within days, Assuta was such a hit that the manufacturer needed two months to catch up on orders. In 1993 they sold about 160,000 bottles, and in 1994 twice that amount.

That same year a well-known dentist from London, Phil Stemmer, flew in to see me in Tel Aviv. He was interested in setting up a clinic for diagnosing and treating bad breath, similar to the one I had in Tel Aviv. During his visit, Phil was introduced to our two-phase "Assuta" mouthwash, which was selling briskly throughout Israel. Phil fell in love with the mouthwash, packed suitcases full of it, which he brought back to his clinic, where he received enthusiastic feedback from his British patients. Soon Phil was talking his friends and relatives into bringing suitcases of "Assuta" mouthwash from Israel back to the UK. He then successfully negotiated a license from Tel Aviv University. The British version, "Dentyl pH," took off very slowly at first, but went on to become one of two leading mouthwash brands (Dentyl pH) throughout the UK. The UK company was bought by a large international corporation (Blistex), and is sold in Australia, Cyprus, South Africa and elsewhere.

And as for me? I continue with our laboratory research, new inventions and our new websites.



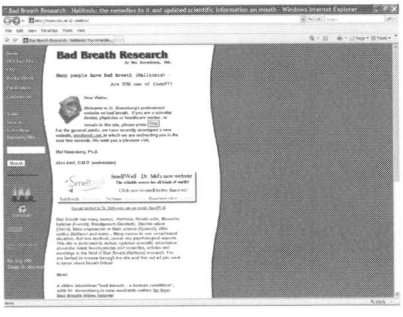
Scientific books:

Bad Breath: Research Perspectives, M. Rosenberg, ed., Ramot Publishing, Tel Aviv University, second edition (1997)

Bad Breath: A Multidisciplinary Approach, Daniel van Steenberghe and Mel Rosenberg, eds., Catholic University Leuven (1996).

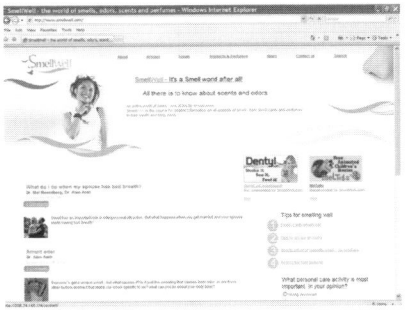
Websites:

Professional: Since August, 1996, Tel Aviv University has hosted a website on bad breath www.tau.ac.il/~melros/.



The site offers lists of upcoming meetings and seminars, questions and answers on various aspects of the problem, a publication list and excerpts from articles, books, etc. The site has already hosted some 2,000,000 visitors.

Free video resource (professional interview with Prof. C.A.G. McCulloch, University of Toronto): www.smellwell.com/videos



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Bad breath is a common, unpleasant condition, affecting some 10-30% of the adult population on a regular basis. Bad breath has important dental and medical implications. It also has a significant personal and social impact, and thus most of us worry about it to varying degrees, whether we have it or not. Some people with bad breath have been told about their problem, but do not know what to do about it. This is unfortunate, because in the vast majority of cases, bad breath can be alleviated, or completely eradicated.

This book, intended for the general public, as well as the professional community, provides expert answers to the most pressing problems regarding halitosis. Dr. Rosenberg explains where bad breath comes from and offers a wealth of advice on how you can find out whether or not you have it, and then eradicate it.

Dr. Mel Rosenberg is a Professor of microbiology and international authority on the causes, diagnosis, and treatment of bad breath. He has carried out extensive research, examined thousands of patients, developed new products and techniques, and lectured worldwide to dentists and physicians.

"Mel Rosenberg, the author of this book, is a world - renowned microbiologist and oral diagnostician who has devoted the last 25 years of his scientific career to discovering the causes, prevalence and treatments of bad breath. In this book Mel demonstrates his complete mastery of the subject, demonstrating a remarkable, multi-layered approach to a very complex problem."

Dr. C.A.G. McCulloch, University of Toronto

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